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Beneath the radar net there is a vulnerable gap which is exploited by the Blackburn NA. 39 low-level strike aircraft.

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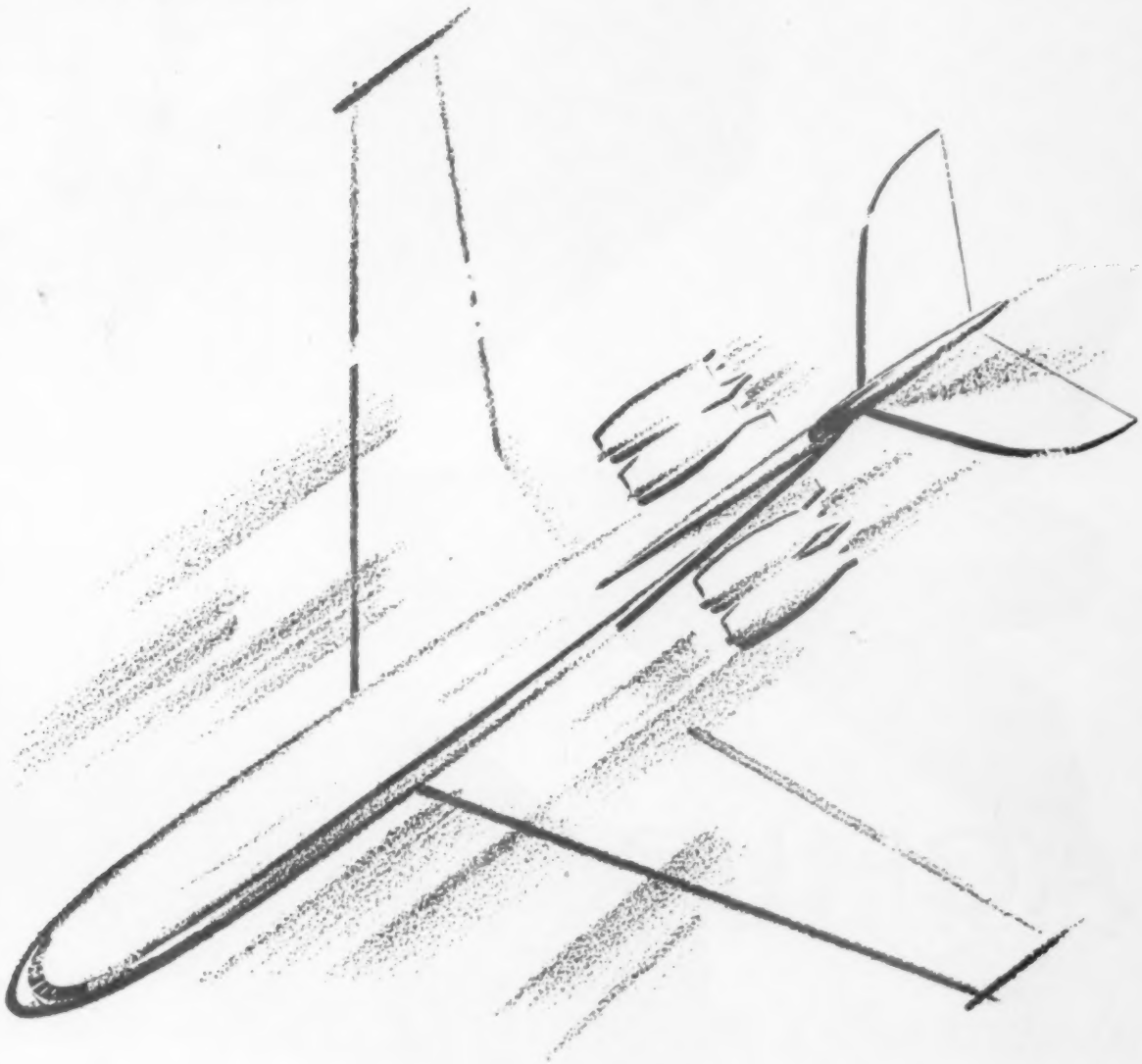

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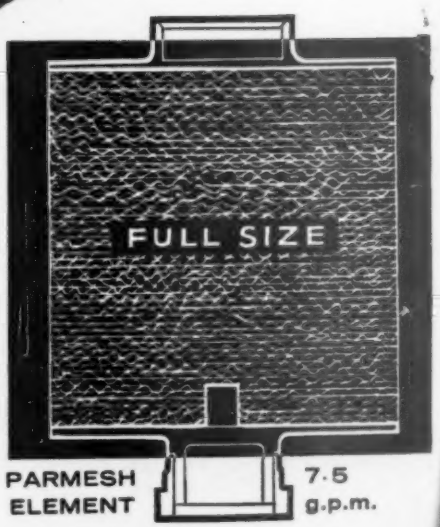
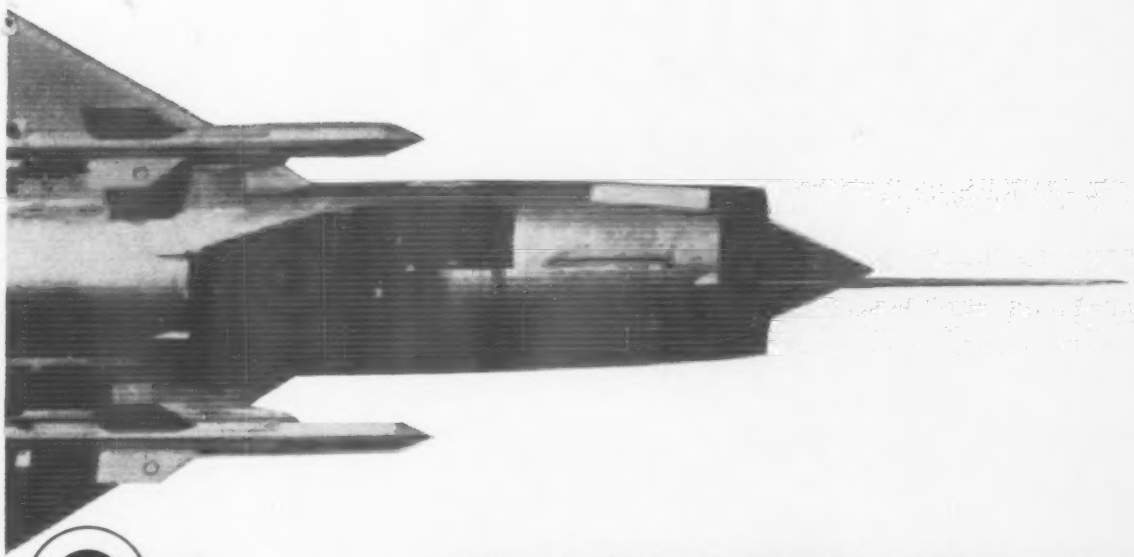


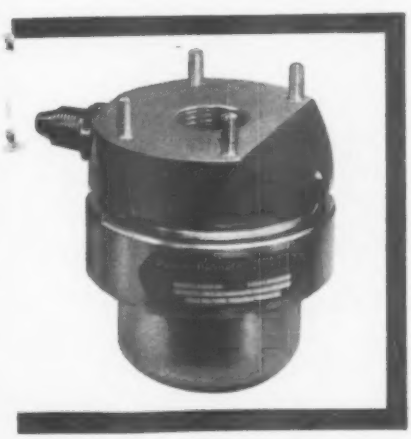
PARMESH ELEMENT 7·5 g.p.m.

A1



Palmer PARMATIC FILTERS

in full production for the 'ENGLISH ELECTRIC' LIGHTNING



Designed to operate at system pressures of 3,000 p.s.i., Palmer Parmatic Filters are now in full production; they have been chosen by English Electric because of the considerable weight and space advantage in relation to their capacity, and because they are unaffected by extremes of operating temperatures.

The filter medium is fabricated from Parmesh, an extremely fine stainless steel cloth suitable for use with all hydraulic fluids, including DTD. 585, "Skydrol", and DP.47.

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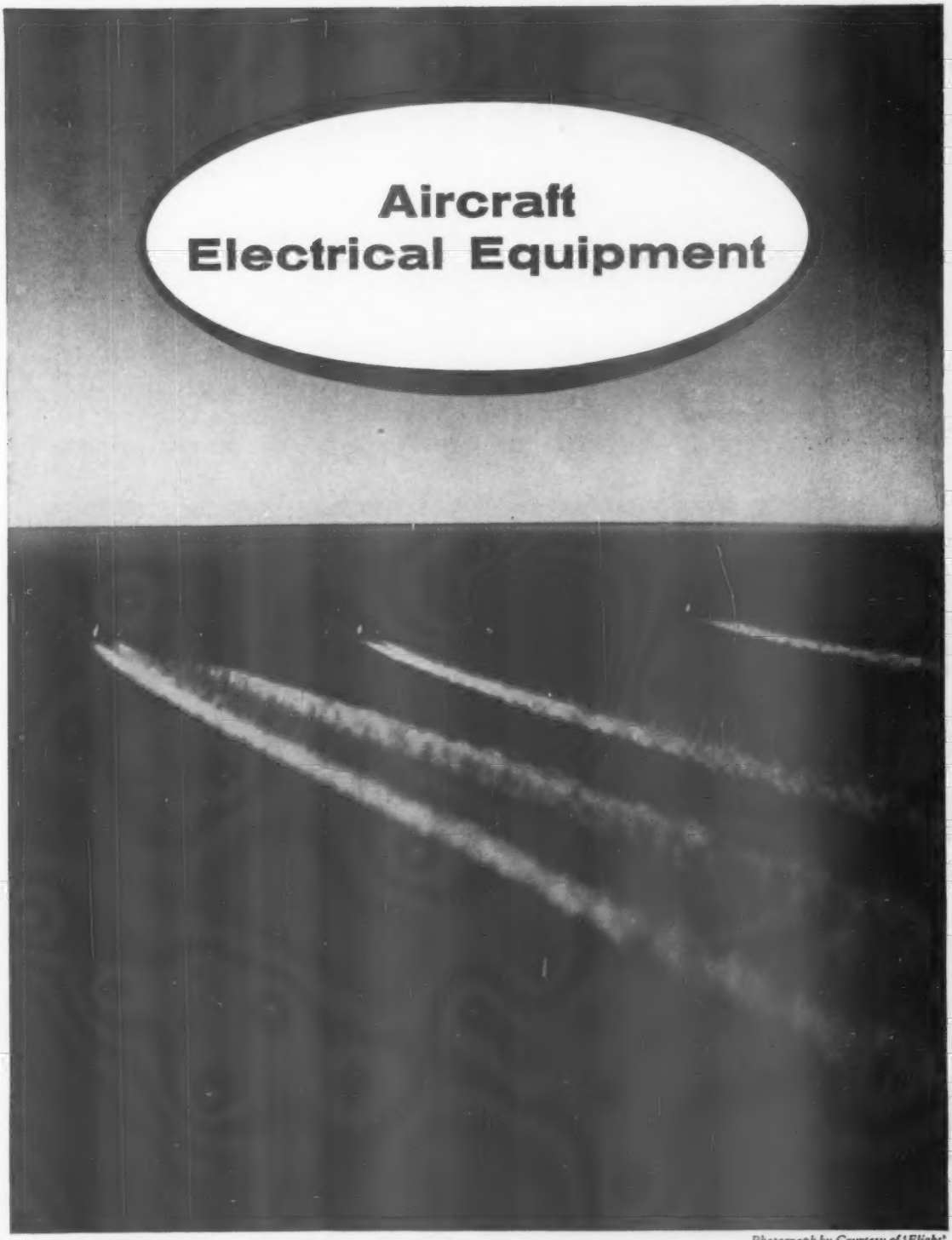

Photograph by Courtesy of 'Flight'

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A5519

NOW THE STOL* HERCULES

*short take-off and landing

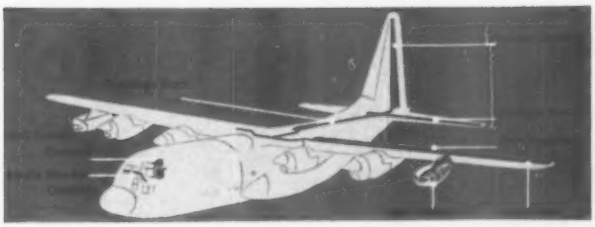
A boundary layer control system, which will spectacularly shorten the already astonishingly brief take-off and landing runs of Lockheed's versatile 61-ton C-130 Hercules transport, is now in an advanced stage of development and flight test.

The Lockheed BLC system culminates many years of study by Lockheed engineers and follows four years of research devoted to specific application of the system to the Hercules.

Four auxiliary jet engines, weighing only 500 pounds each, will furnish the streams of high pressure air which flow over all control surfaces. The BLC jet engines are each connected to a central system providing air evenly to all surfaces even with one engine out.

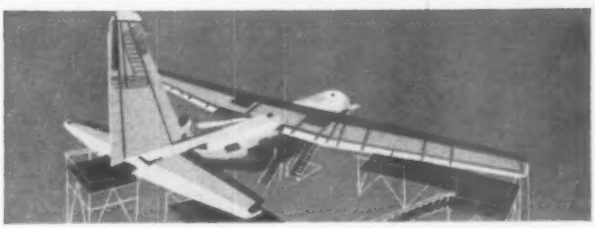
Manufacturing work on the BLC Hercules can begin now because 80% of the airplane is identical to the C-130 B. In Europe, a nation or group of nations could manufacture the C-130 B and have a European version flying in less than half the time required by a new untested design. The program could then be phased into the more advanced BLC Hercules. Know-how acquired by Lockheed in manufacturing nearly 300 C-130s to date can make the BLC Hercules European manufacturing project the most rapid and inexpensive answer to the needs of European nations for a high performance, all-purpose transport.

As a combat transport of men and equipment the C-130 showed its superlative value in airlifts to Lebanon and Turkey.



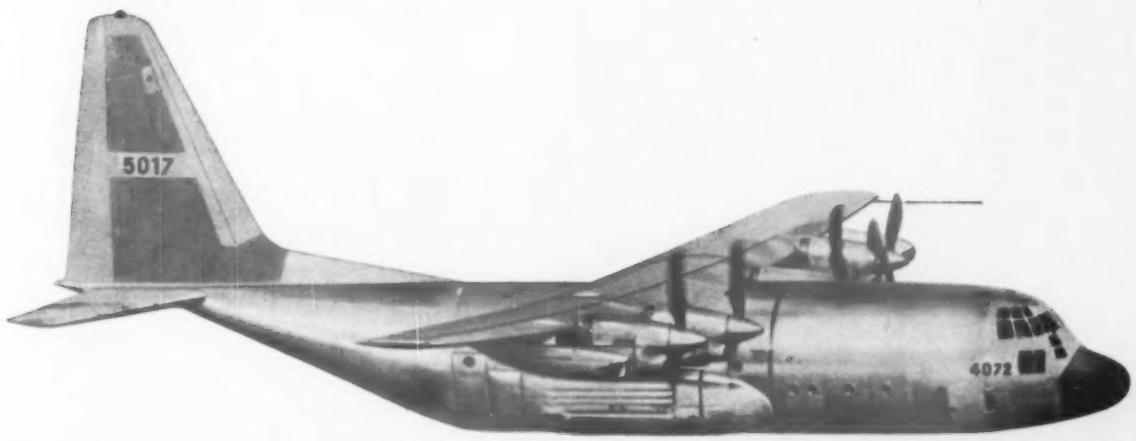
Boundary Layer Control

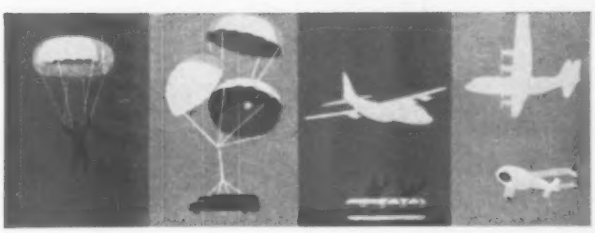
This illustration shows the Boundary Layer Control system of the Hercules. A pod under each wing carrying two small modified jet engines bleeds air which flows over all control surfaces, ailerons, flaps, rudder and elevator greatly reducing stall speed of the 61-ton transport.



Licensed manufacture

The Hercules is easily adapted to licensed manufacture. Plans for its production in Europe by a nation or nations cooperating with Lockheed have been carefully studied. Results emphasize spectacular saving of both money and time.





Versatility

The excellent range capabilities of the C-130 enable it to perform long search and patrol missions. Moreover, it can be easily adapted to many different mission configurations including Paratroop Drop, Aerial Cargo Delivery, Air Rescue, Drone Launcher / Director Aircraft, Troop Carrier, Air Refueling, Aerial Mapping and Surveying, etc.

Soft Field Take-off and Landing

The unique landing gear design of the C-130 permits it to operate from soft, unprepared fields. High gross-weight landing tests have been made on grass, sand and pierced steel plank. The C-130 is the largest aircraft to be equipped with skis for snow and ice landings.

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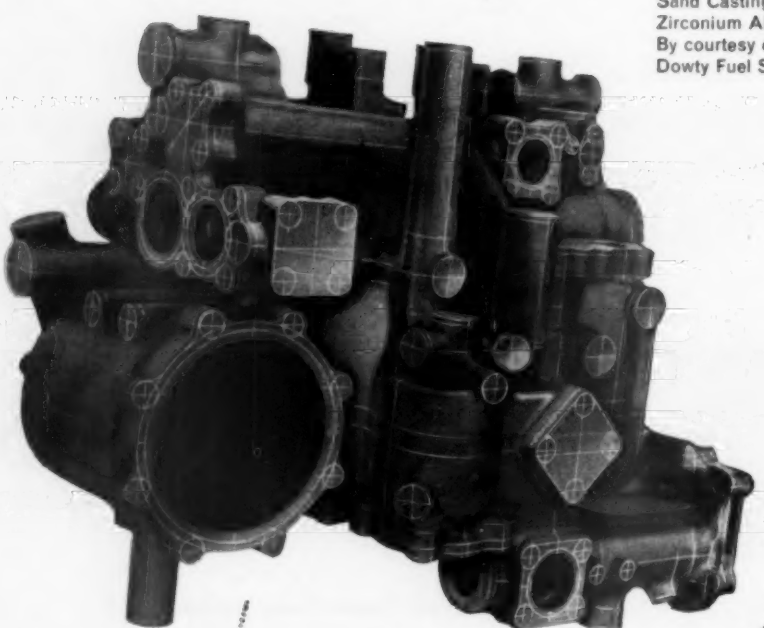

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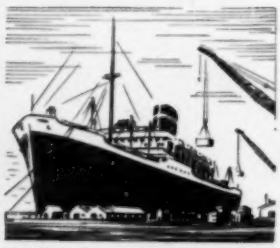
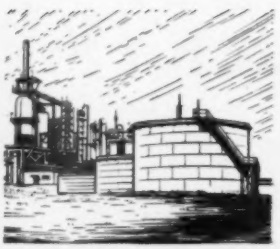
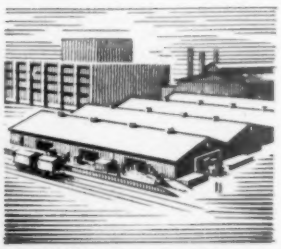


SHIPPING *As well as protecting ships of the Royal Navy, Pyrene Fire Protection Systems safeguard passenger and cargo ships, tankers, tugs, docks and harbours throughout the world.*



OIL *In the processing and storage of oil, and the production of petroleum, fuel and lubricating oils and all by-products–highly specialized Pyrene Fire Equipment—mobile, portable or fixed—is in universal use.*



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of to-morrow. We would like to offer the service of our research engineers if you are faced with any form of fire hazard concerning modern aircraft or airfields. Please write to DEPT (A.9) 9 GROSVENOR GDNS., LONDON S.W.1 *Tel:* VICTORIA 3401. We shall look forward to meeting you at **S.B.A.C. FARNBOROUGH** Indoor Exhibition Stand No. 63. Outside Exhibits ("Pyrene" Crash Tender) Site E. Enclosure C.7.

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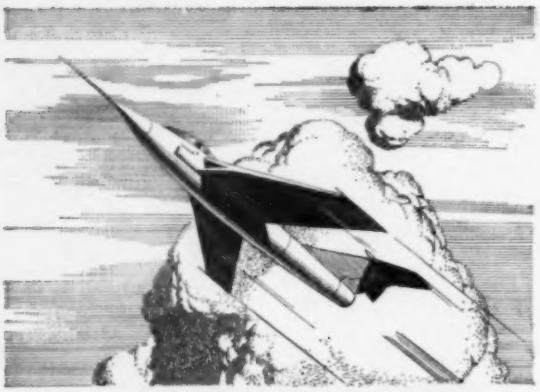

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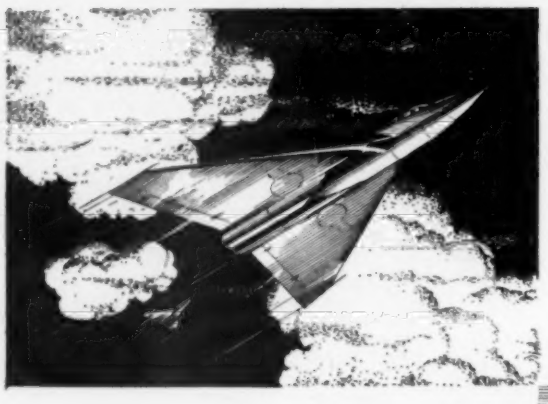

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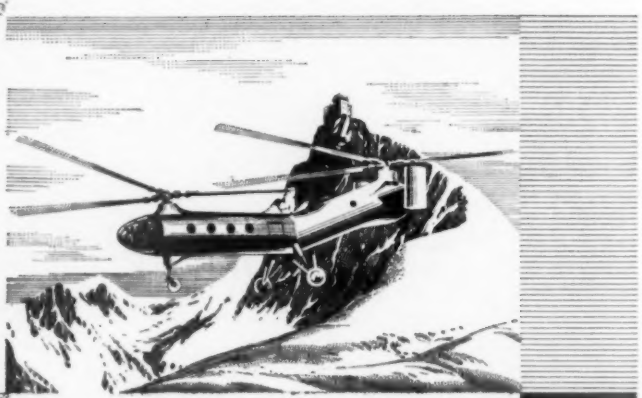

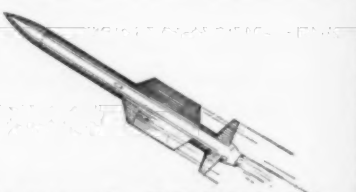

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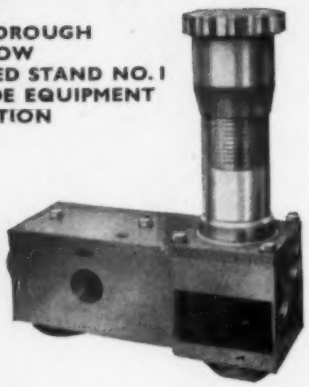

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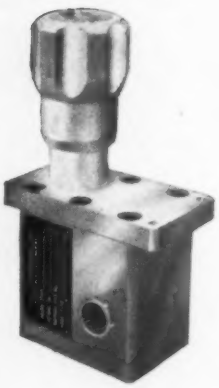

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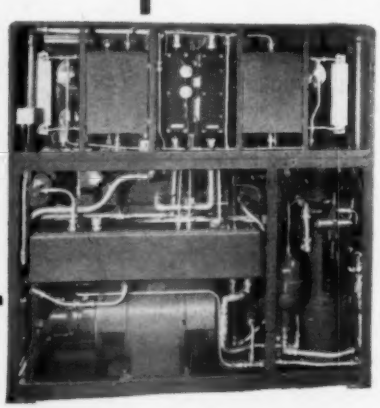

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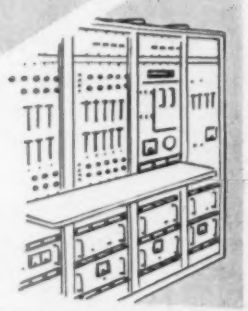

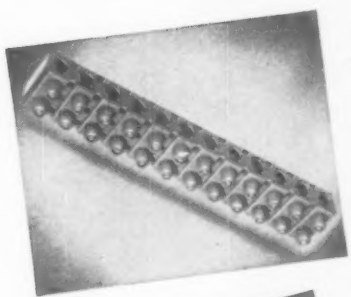

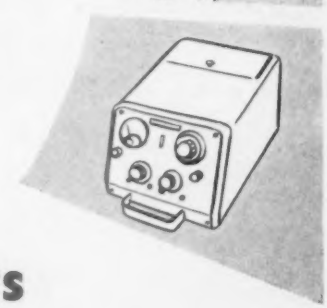

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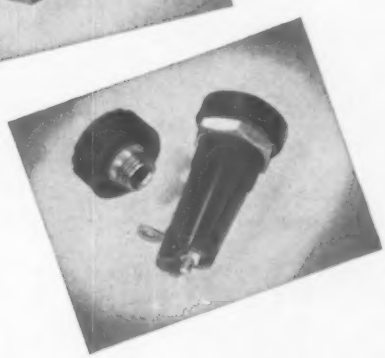

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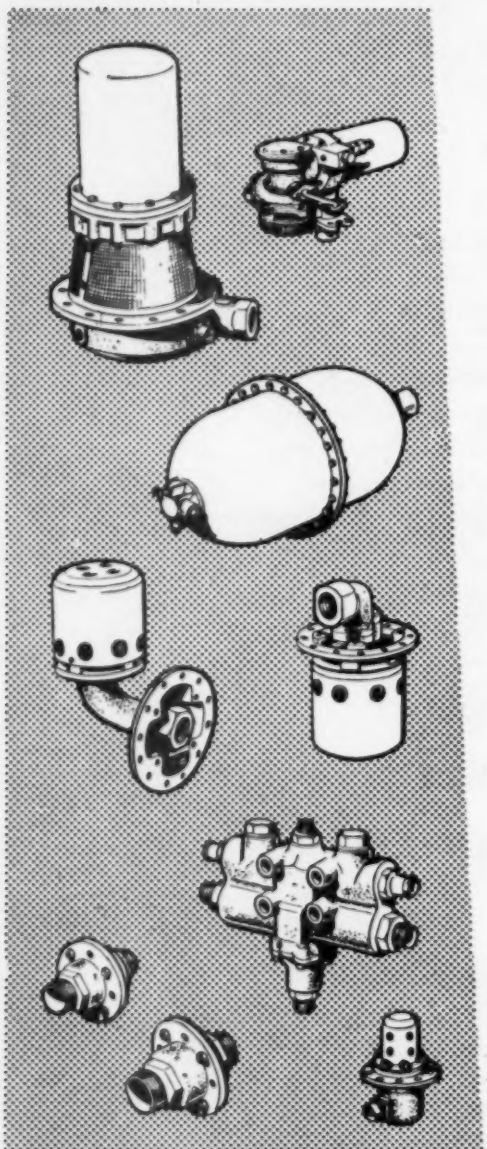

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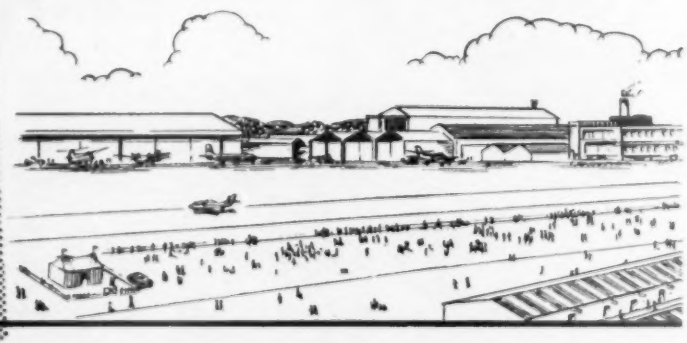

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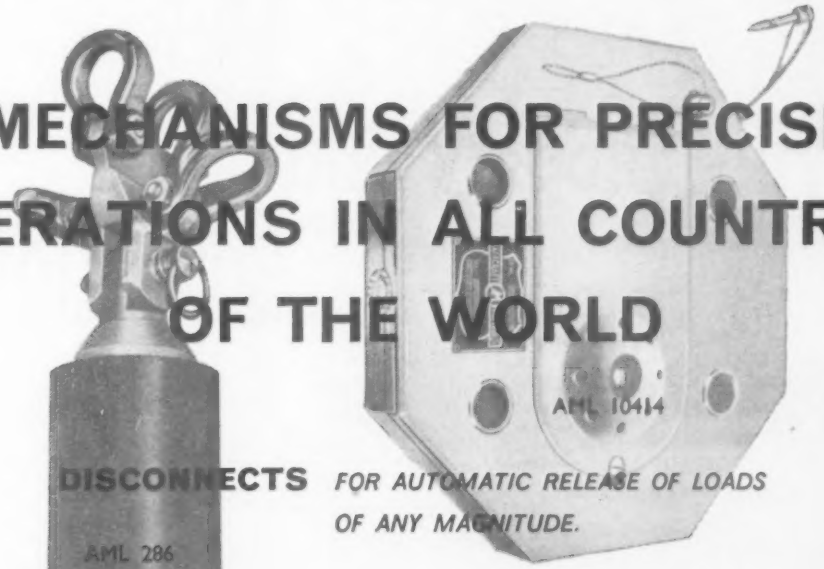

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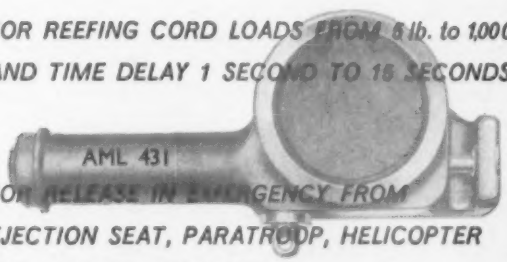

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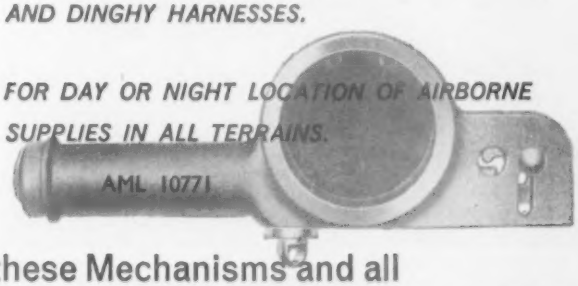

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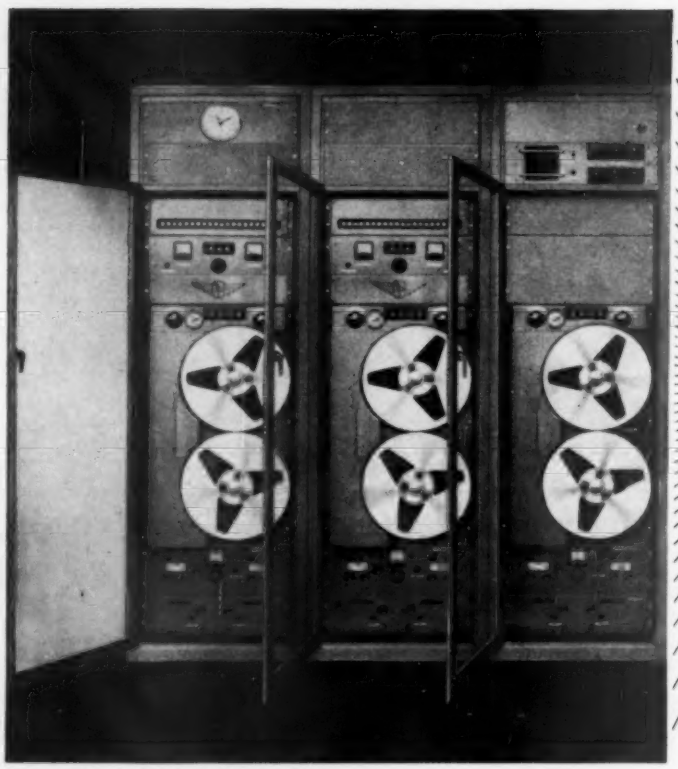

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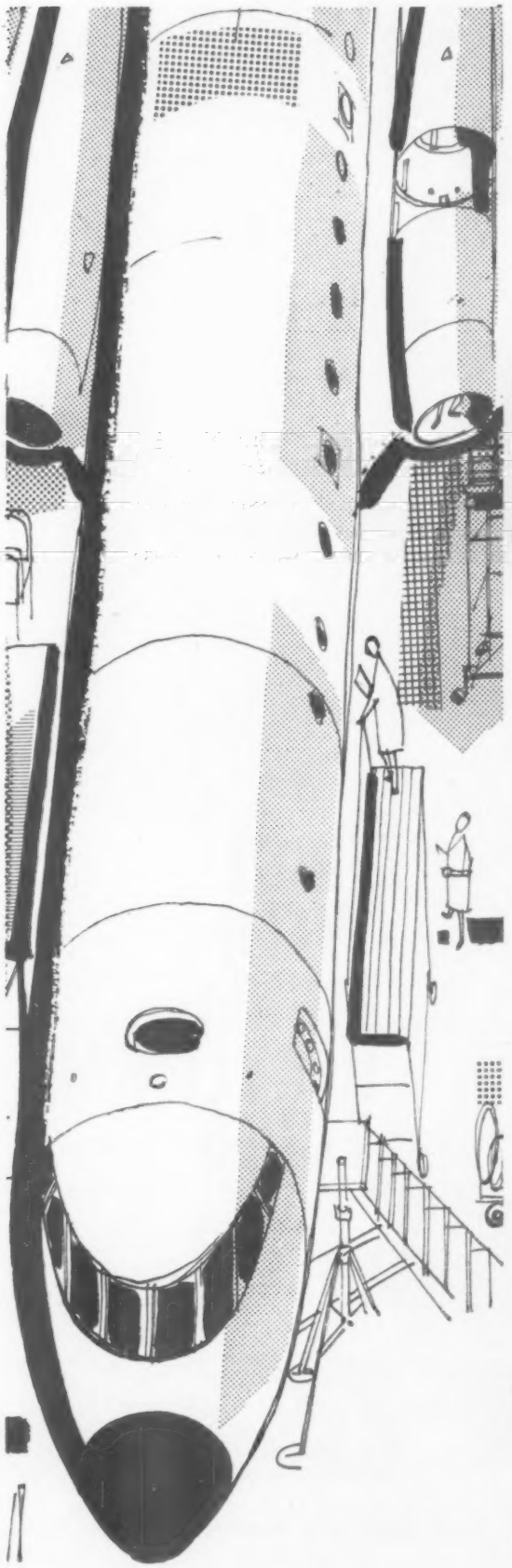

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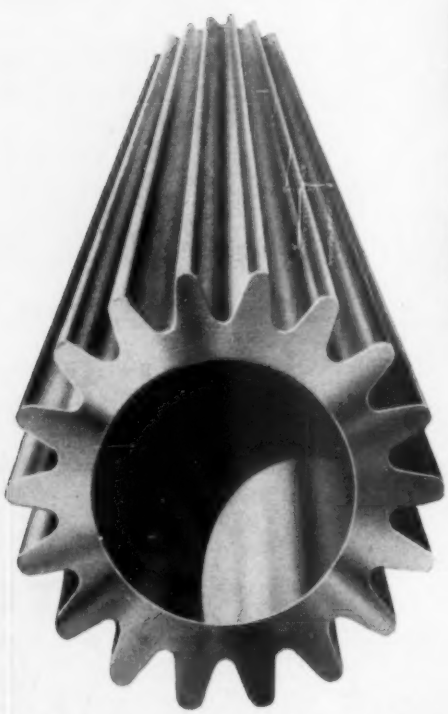

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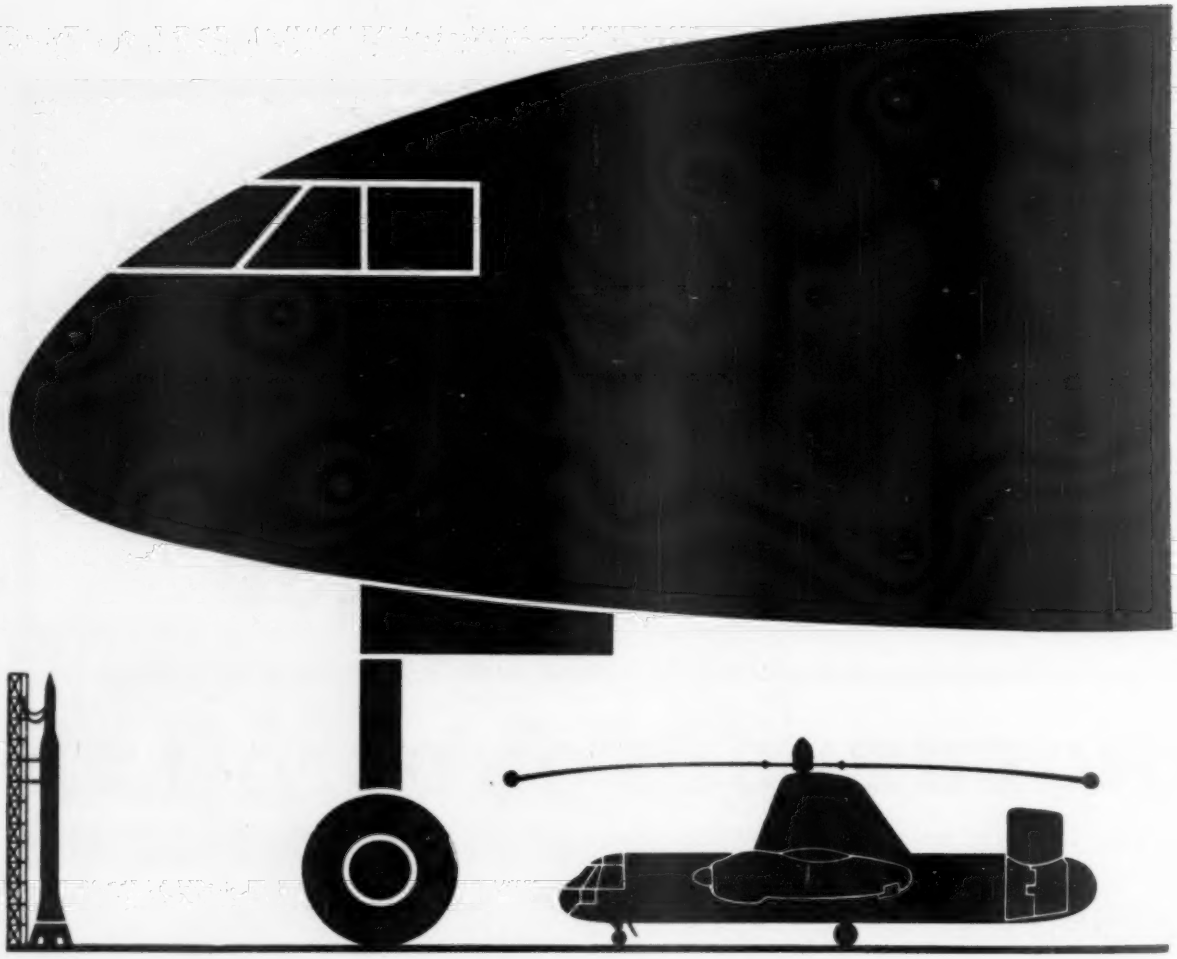

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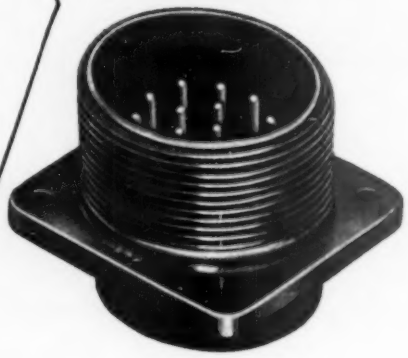

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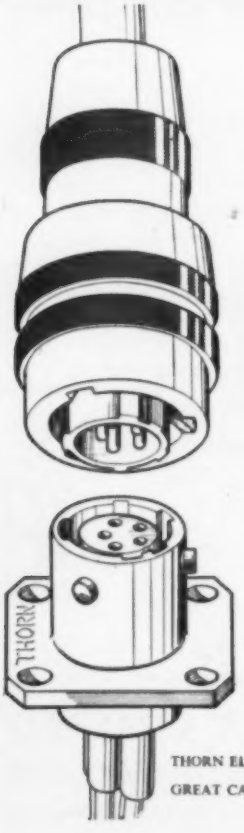

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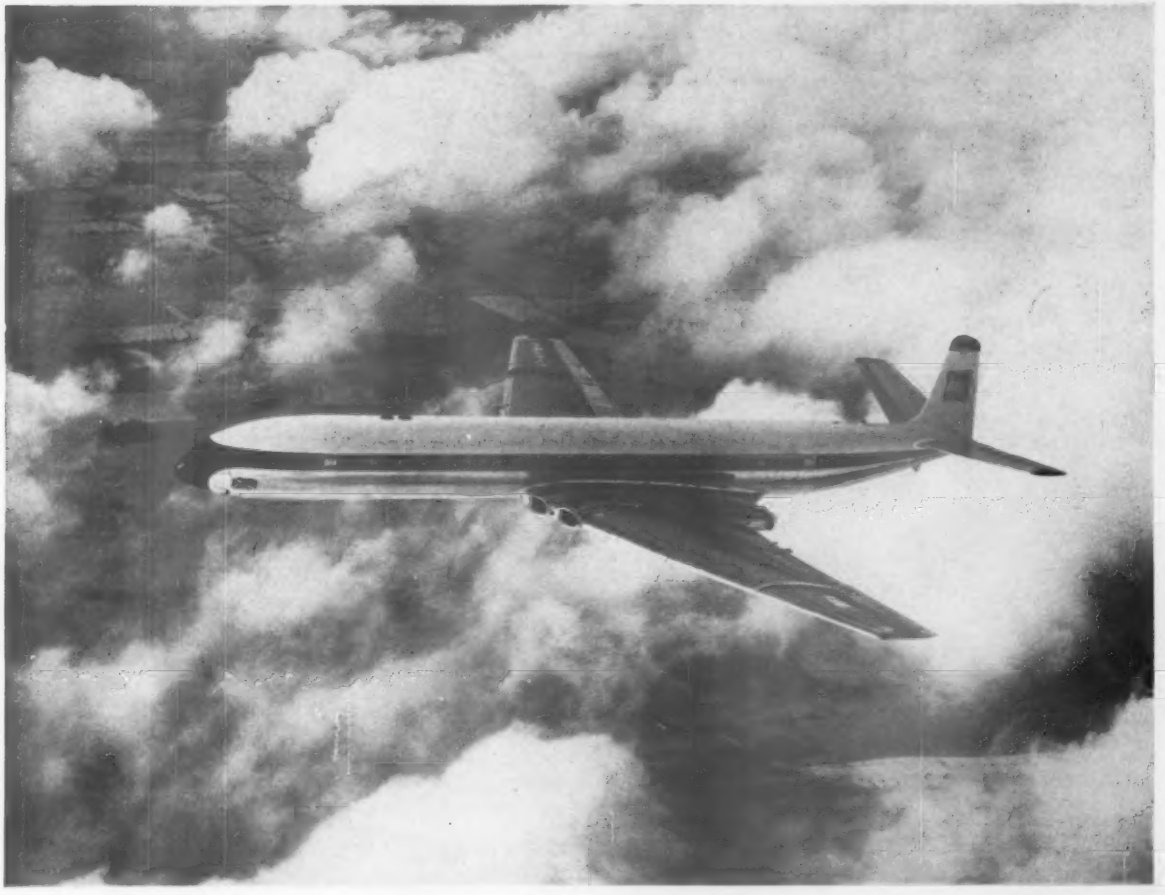

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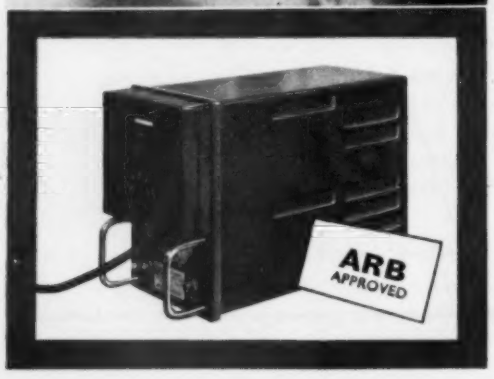

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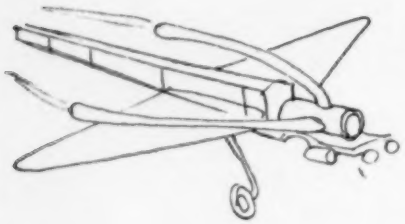

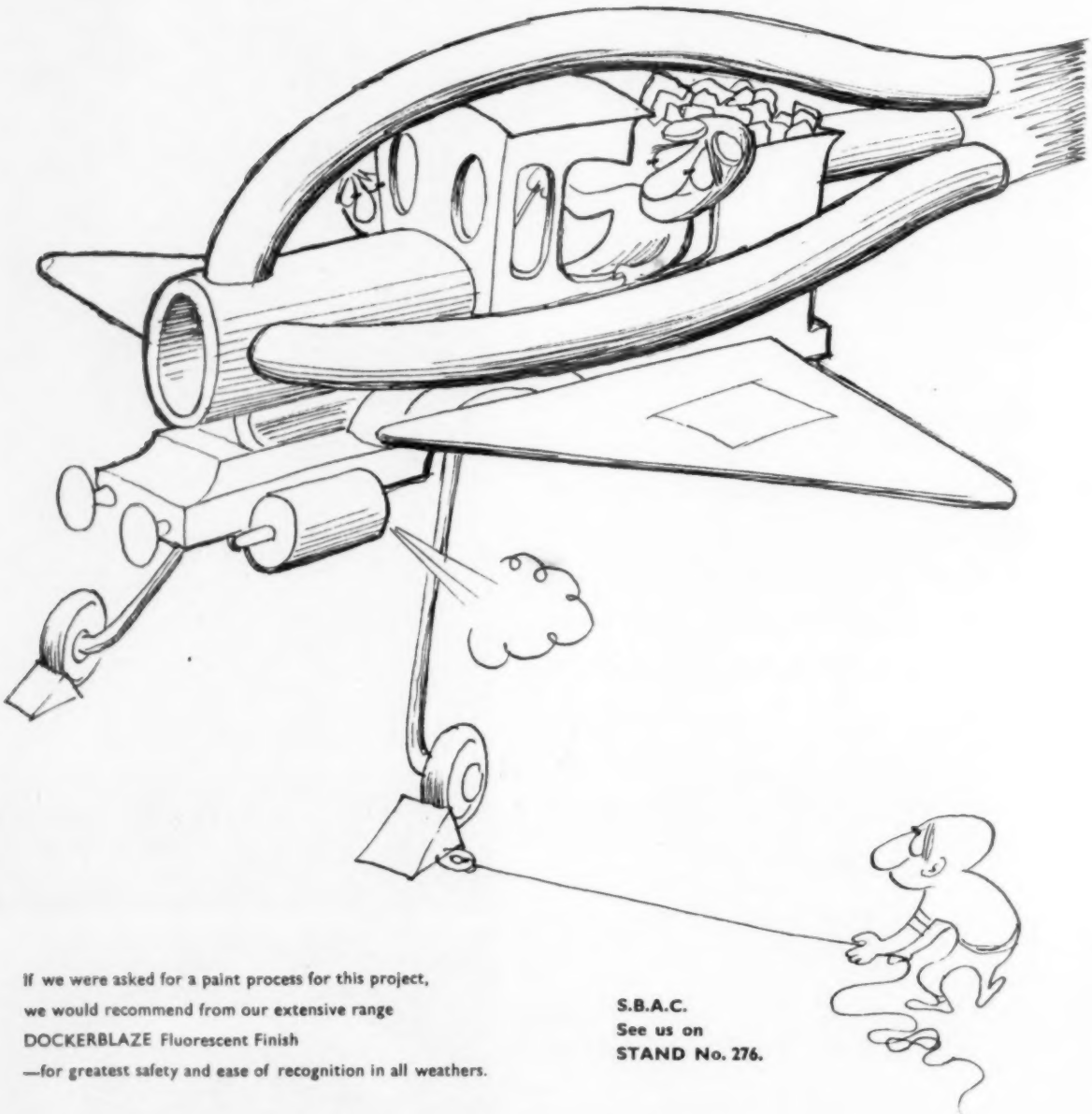

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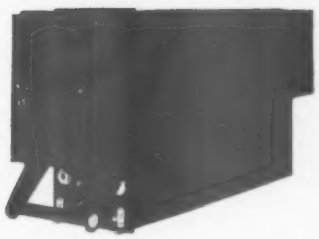

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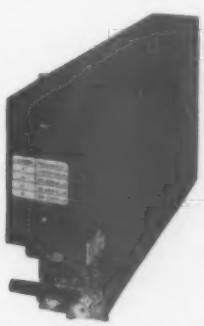

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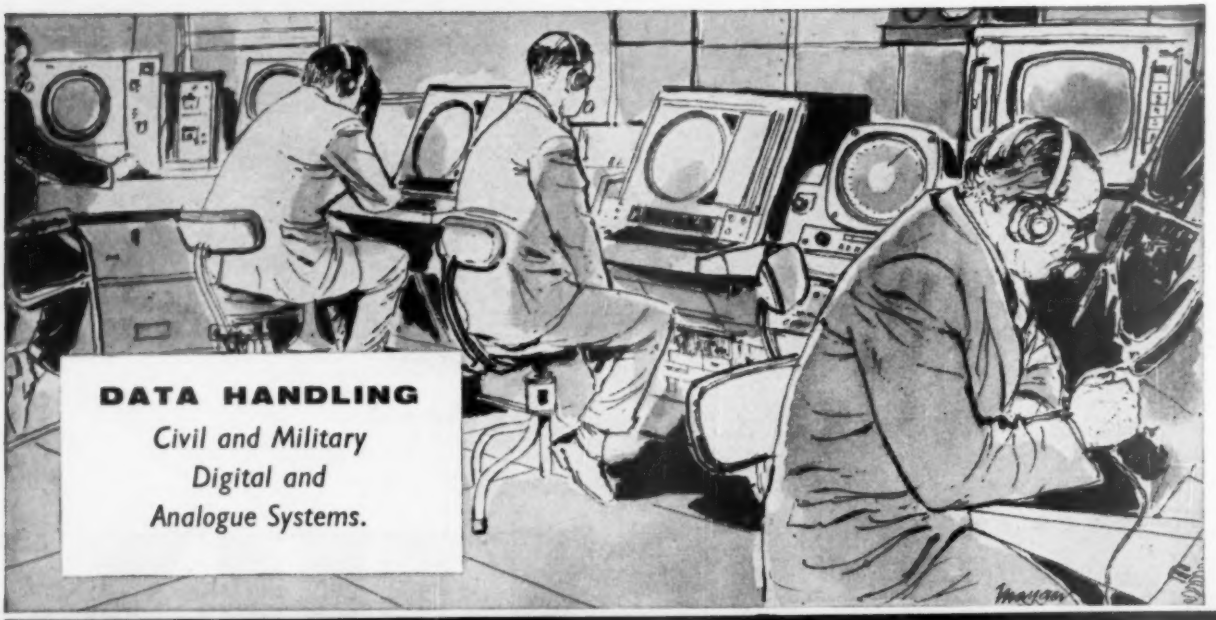

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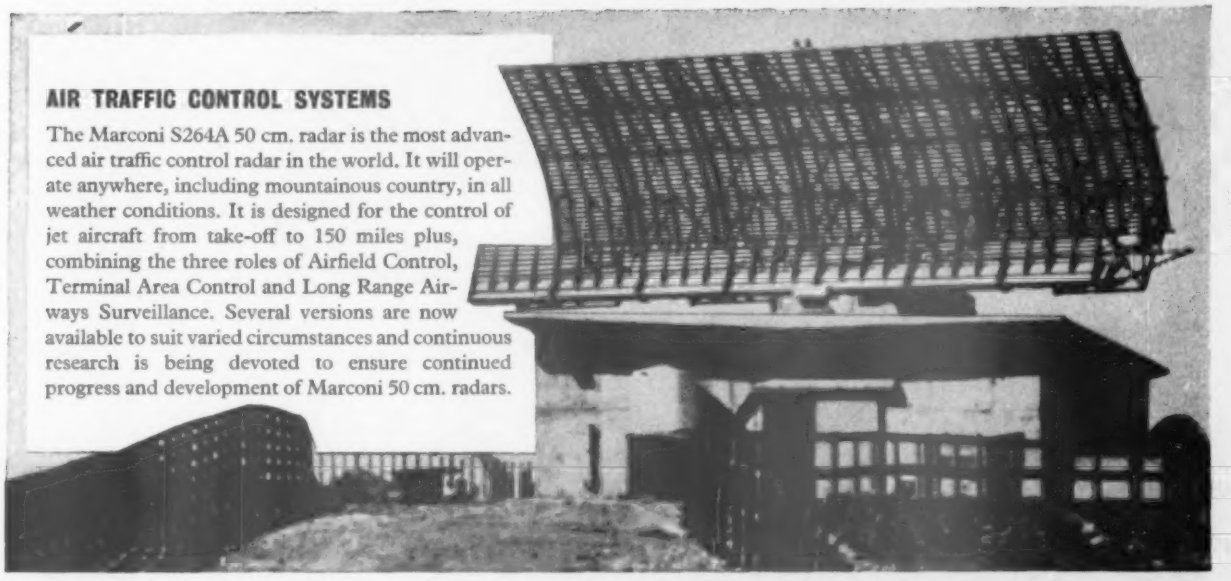

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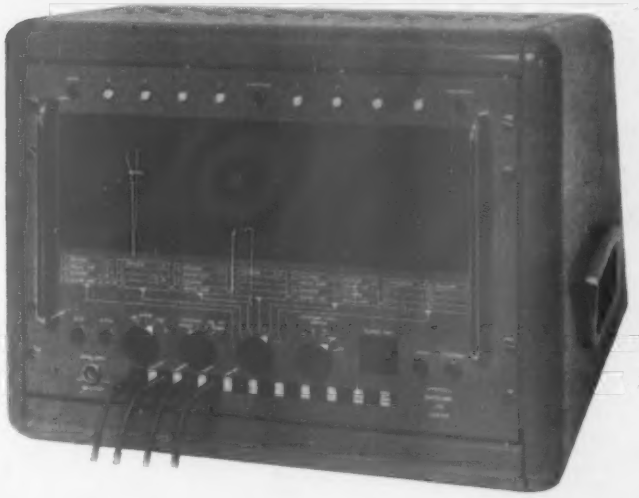

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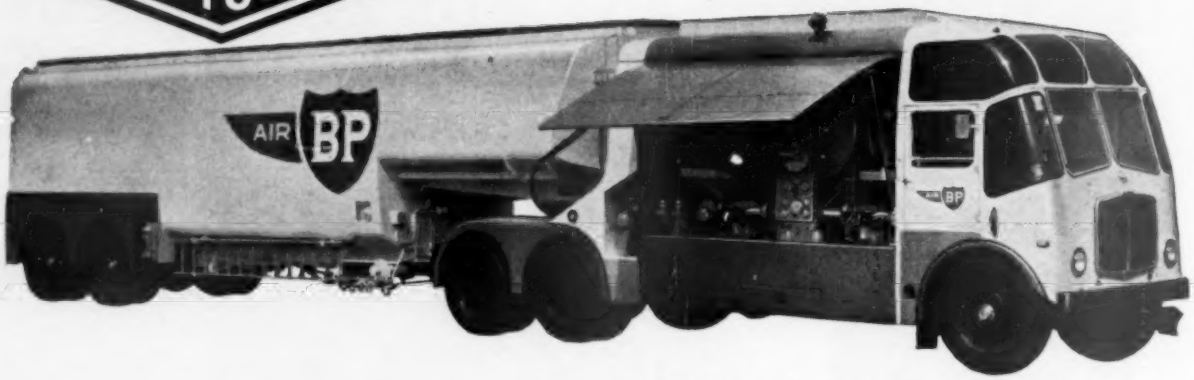

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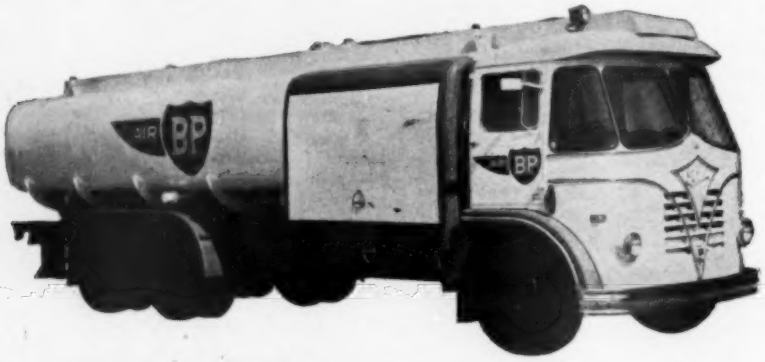
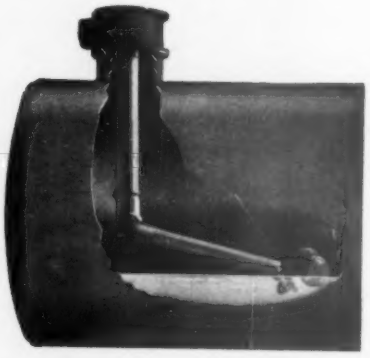
10,000 gallons capacity, mounted on an A.E.C. Mammoth Major Mark III 6-wheel chassis. With a 3" hose, a refuelling rate of 600 I.G.P.M. on a single line service can be maintained. Fitted with a Filter/Separator Unit.



HERTFORD REFUELLER

A higher capacity refueller—with an extra measure of efficiency. 3,680 gall. capacity—two hose reels, for either 150 g.p.m. through each 100 ft. of 2" bore hose, or 250 g.p.m. through each 60 ft. of 2½" bore hose or 100 ft. of 2½" collapsible hose. Alternative open line refuelling rate of 120 g.p.m. through each line.



FLOATING SUCTION UNIT

Designed to ensure that clean fuel is drawn at all times from the highest level of liquid, allowing sediment and water to settle in the tank. A low level cut-off switch can be incorporated.

B.P./ZWICKY SHOCK ALLEVIATORS

This liquid shock damper considerably reduces fluid peak pressures when fast valve closures occur. Particular applications are the protection of aircraft tanks, meters in the pumping circuit, nozzles, hoses and pumps.

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ZWICKY LIMITED

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needs . . . . down to the ground

ANGUS DISPENSER

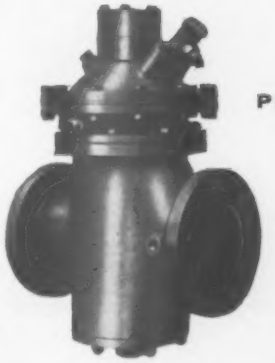
The unit is mounted on a Karrier Gamecock 9′ 7″ Chassis and is powered by a light diesel engine fitted with a side power take-off. Capacity is either 600 I.G.P.M. at 32 p.s.i. or 750 I.G.P.M. at 48 p.s.i. through two 60′ x 3″ hoses.

NOZZLES

Zwicky Nozzles are produced as trigger operated and automatic shut-off types. They incorporate a strainer and have a very high performance, suitable for a wide range of fluids. Newest addition to the range is the Zwicky 2″ Slow-Close Nozzle.

RUNWAY SWEEPER/COLLECTOR

Now, more than ever, it is absolutely essential to have clean runways. The Zwicky Runway Sweeper/Collector is capable of sweeping over 650,000 sq. ft. per hour and can be completely controlled from the driver's cab by one operator.



PRESSURE CONTROLLERS

Designed primarily for aircraft refuellers, hydrant dispensers, or hydrant mains systems, these controllers have a high degree of sensitivity.
They are adaptable for a variety of duties.

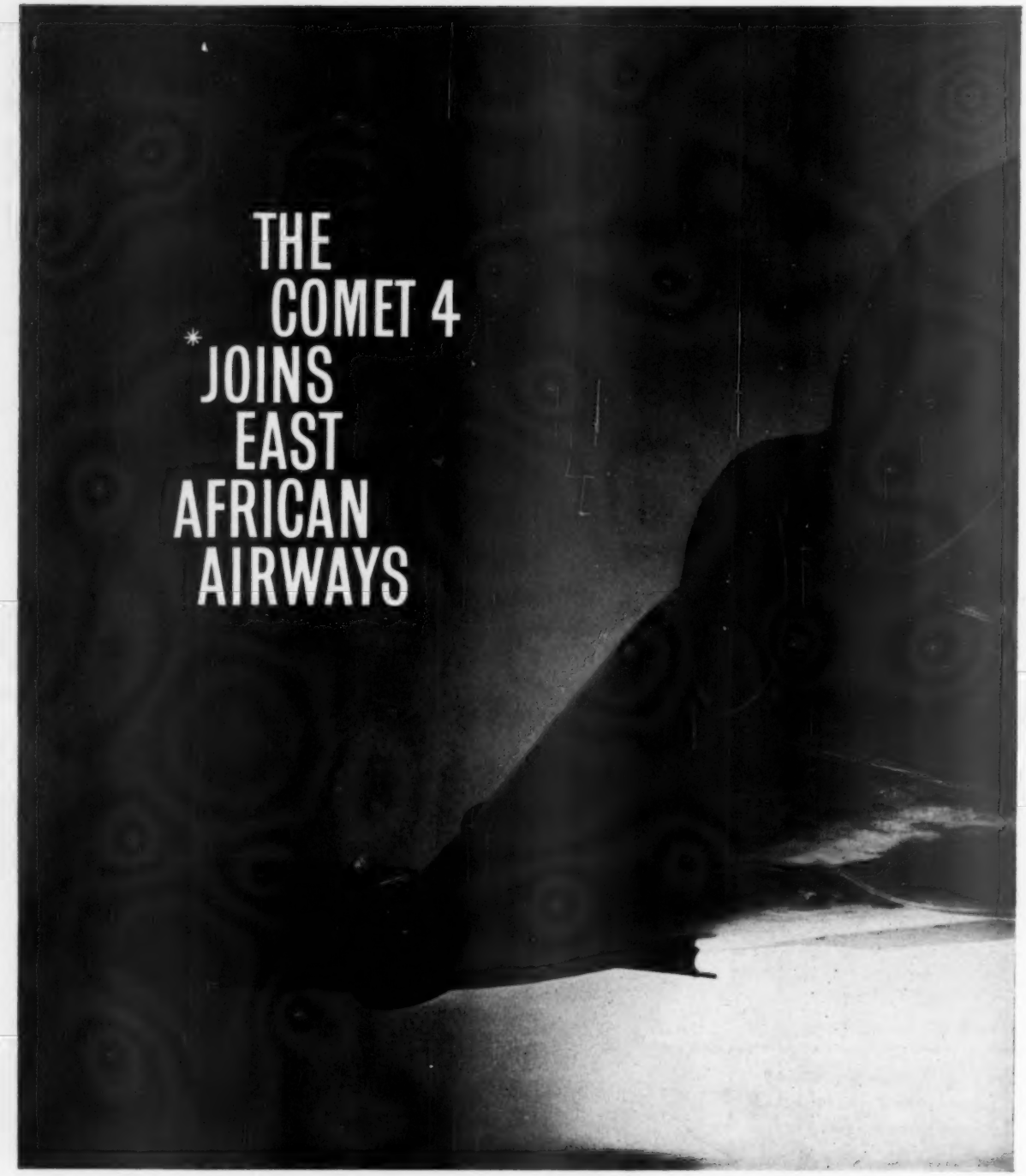
VENTURIS

Zwicky manufacture for use in conjunction with their pressure controllers, a wide range of fixed and variable venturis for calibrated sensing of hose end pressures.

Zwicky Products include
FILTERS · PUMPS · HOSE REELS
and a wide variety of
VALVES · SWIVEL CONNECTIONS
EMERGENCY STOP CONTROLS

All Zwicky Refuelling Units and Hydrant Dispensers can be supplied fitted with water separators.

SPECIALISTS IN FILTRATION, PRESSURE CONTROL & REFUELLING EQUIPMENT



* Inaugural flight London-Nairobi mid-August, 11 hours flying time. Three flights per week thereafter, in each direction. One flight continues to Dar-es-Salaam.
Contact your travel agent for details.

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Because of their reliability, precision and long life, Honeywell Micro Switches get (and give) VIP treatment wherever switching circuits are devised.

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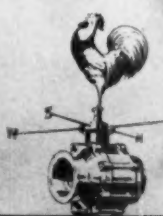

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STAND N° 220

SAUNDERS VALVE COMPANY LIMITED
Aircraft Division
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From the coracles of prehistoric times to the jet airliners of to-day, fast efficient transport has been the key to the progress of civilization. But with each major improvement, the associated problems of operating each form of transport have grown in complexity, and now demand as much attention as the improvement of the land, sea or air vehicles themselves. In the case of aviation, more airlines, faster aircraft, bigger airports - all combine to compel those in charge of air traffic to cry out for modern, fast data processing equipment. SATCO automatic air traffic control is a practical solution to their problems.

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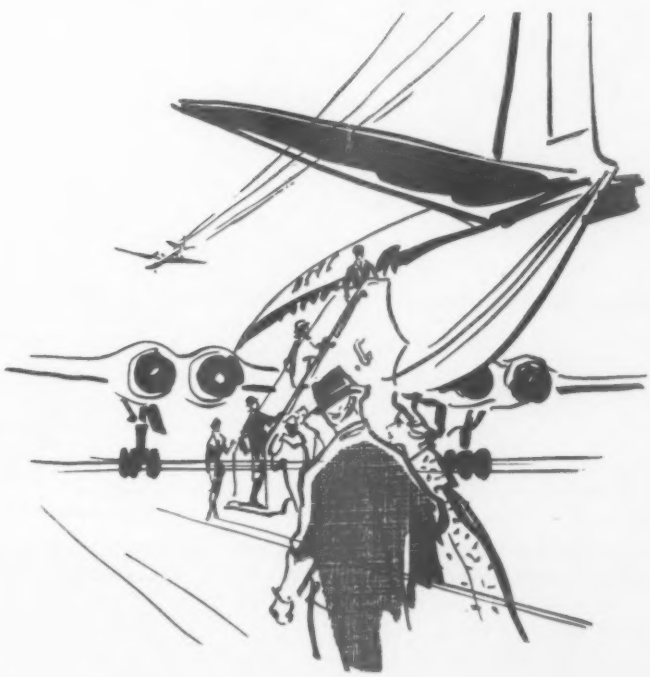
Satco comprises the ground equipment to predict, coordinate, check and display the movements of air traffic en route and in terminal areas. It provides an extremely rapid method of calculating flight paths, for assessing potential conflicts and for coordination between Area Control Centres. Special features are included for military / civil coordination and for the control of jet-powered traffic.

The system has been ordered by The Netherlands Government and the first phase is now on operational test.



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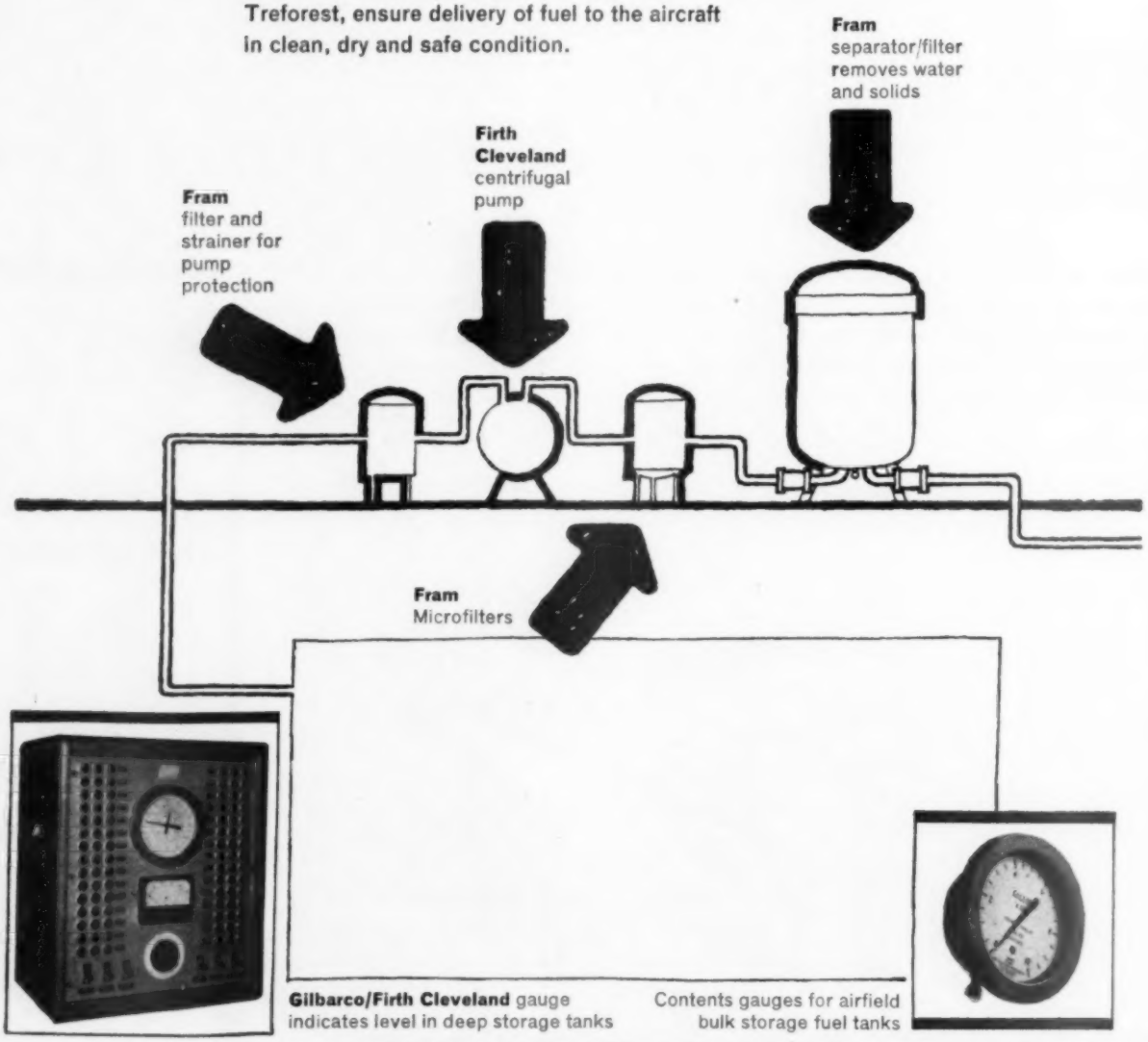
We manufacture specialised equipment for handling aviation fuel at every point from bulk storage to aircraft engine—specialised equipment for filtering, pumping, controlling, metering, transporting, and specialised instruments for indicating fuel quantities and rates of flow.
Our products, which are subjected to stringent tests in the Firth Cleveland Test House at Treforest, ensure delivery of fuel to the aircraft in clean, dry and safe condition.


Fram separator/filter removes water and solids
Firth Cleveland centrifugal pump
Fram filter and strainer for pump protection
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Gilbarco/Firth Cleveland gauge indicates level in deep storage tanks

Contents gauges for airfield bulk storage fuel tanks

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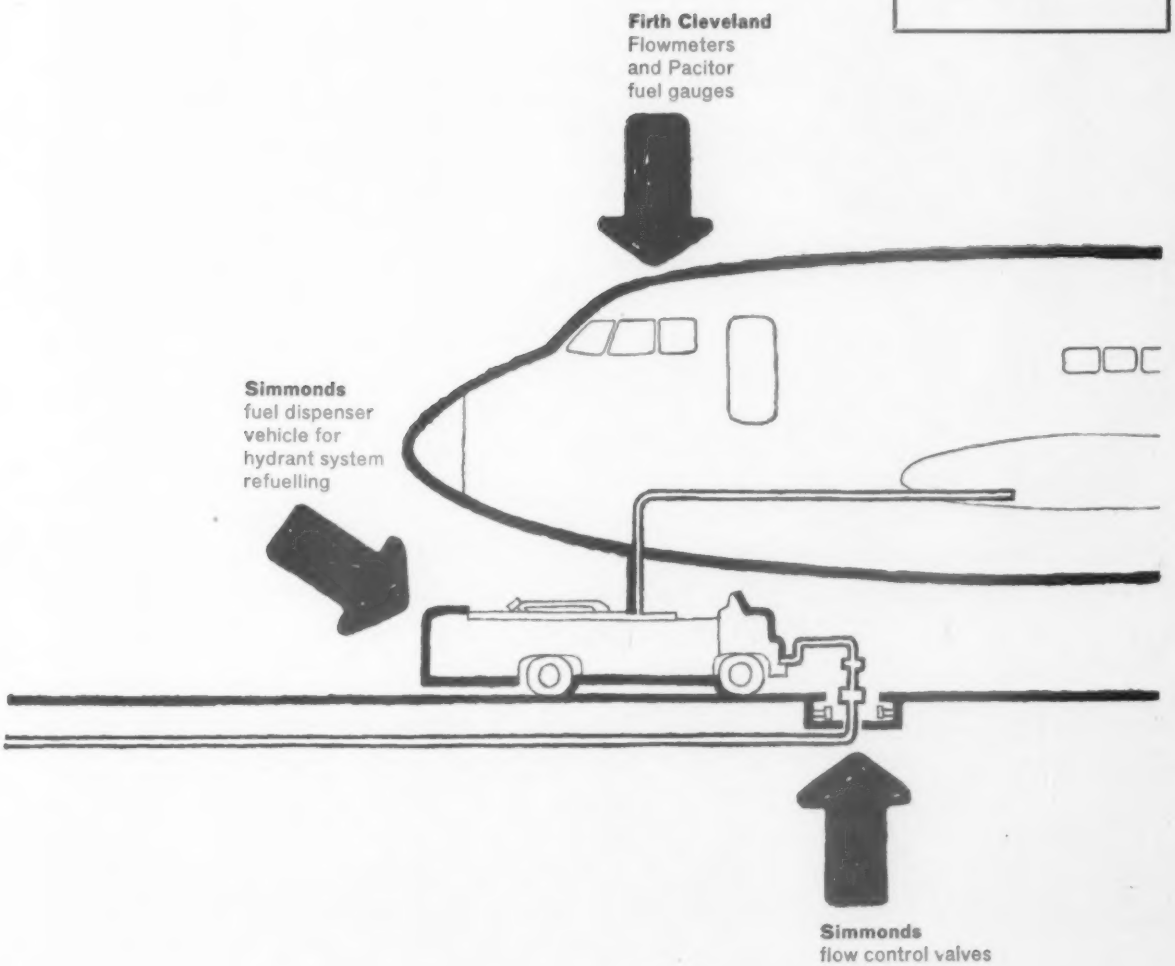
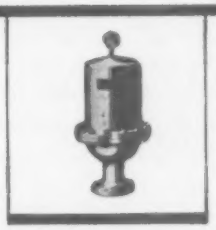


Firth Cleveland flowmeter

Pacitor fuel gauge



Simmonds BP shock alleviators

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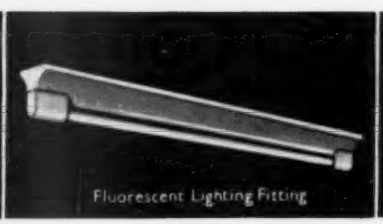

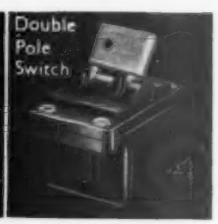

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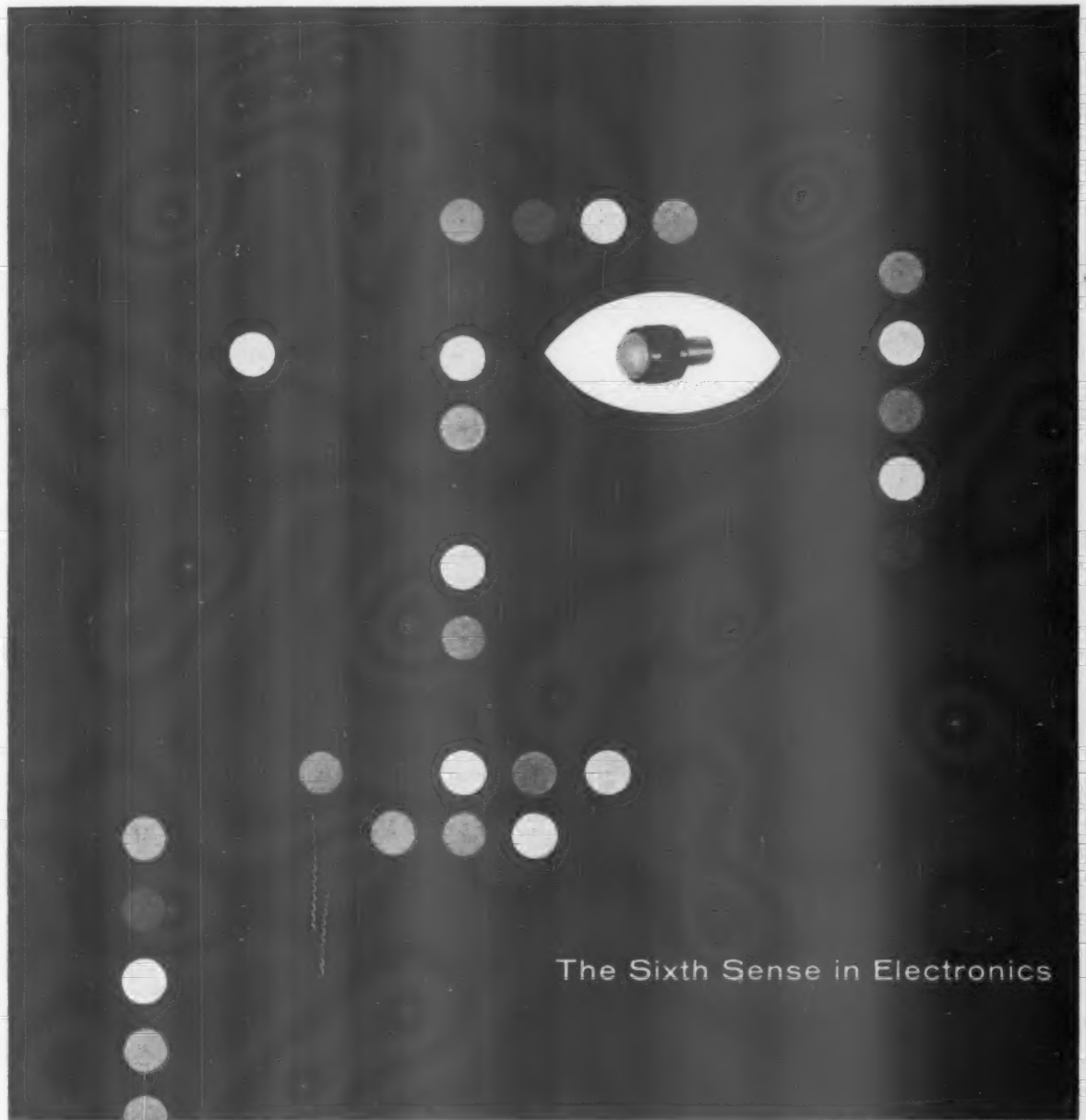

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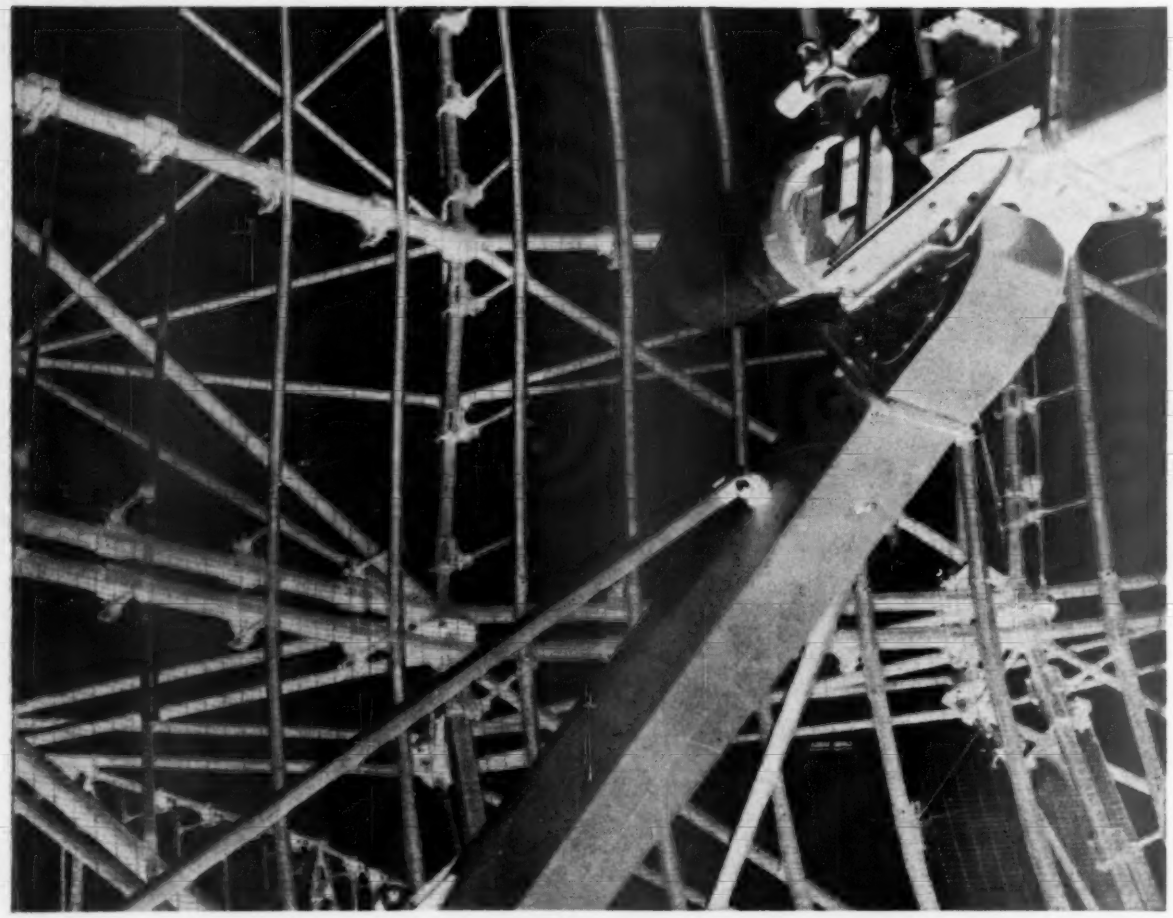

DECCA RADAR IN DEFENCE

To a greater extent than ever before, defence is today a matter of anticipation. The efficacy of different counter-measures is directly related to the accuracy and scope of warning equipment.

This is especially true at the strategical level where massive Decca-built long range radars are constantly ready to set in motion the weapons of interception.

Behind this primary line of protection, however, there are many calls for radars of a like reliability for specialised functions; these equipments, too, Decca design and manufacture, from the very large but transportable installations through the whole range of military radars to the compact equipments that are fitted into aircraft.

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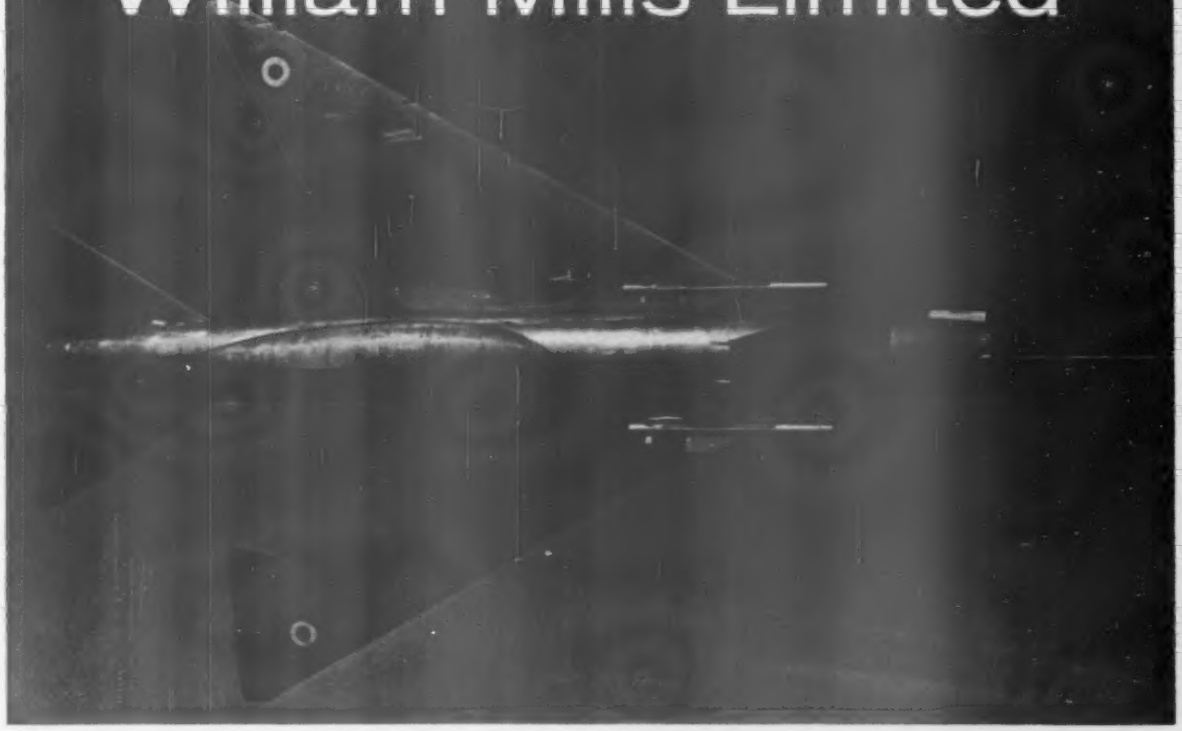
DR 144

Aluminium Alloy Castings

Surface finish castings of close dimensional accuracy for the Specto Camera Gun used in the English Electric Lightning F Mark 1.

by

William Mills Limited

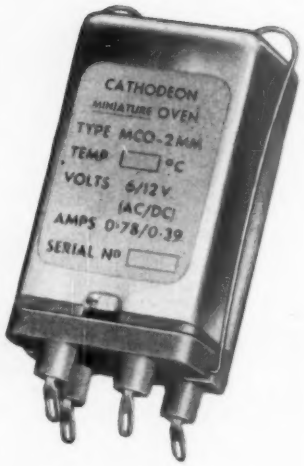


WILLIAM MILLS LIMITED FRIAR PARK FOUNDRY FRIAR PARK ROAD WEDNESBURY STAFFS

AP 137

CATHODEON

MINIATURE THERMOSTATICALLY CONTROLLED OVEN



ACTUAL SIZE

GENERAL DESCRIPTION

This oven was designed specifically for accurate temperature control of Style "J" Quartz Crystal Units but is ideally suited for other components such as transistors, diodes, thermistors, etc., which are sensitive to ambient temperature variations.

Heat control is achieved by a bi-metallic thermal switch.

Capacity of the inner shell $\frac{11}{16}$" x $\frac{3}{8}$" x $\frac{31}{32}$" (2.0 x 0.9 x 2.3 cms).

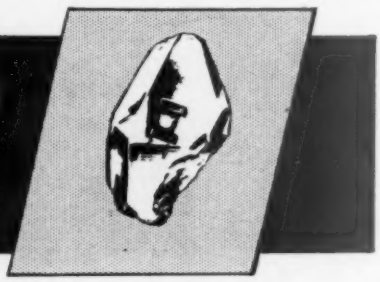
Overall dimensions $1\frac{1}{4}$" x $\frac{11}{16}$" x $2\frac{5}{8}$" long (3.2 x 2.0 x 6.6 cms).

Weight $1\frac{1}{2}$ oz. (43 grms).

OPERATING DATA

6v or 12v supply. Power consumption 4.6 watts.
Temperature settings between 50°C and 85°C.
Standard tolerance on setting is ±2°C but ±1°C can be supplied.
Temperature differential over the operating temperature range is within ±2°C of the setting-up temperature. The heating-up time is less than 5 minutes from +20°C to +85°C.

CATHODEON CRYSTALS LIMITED
LINTON CAMBRIDGESHIRE
TELEPHONE LINTON 501 (4 lines)



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GENERAL PERFORMANCE

Front Deck Hoses: Rated Condition 400 Imperial gallons per minute—200 g.p.m. each line. Suitable for fuelling Caravelles, Comets, etc.

Upper Deck Hoses: 600 Imperial gallons per minute—300 g.p.m. each line. Suitable for fuelling Douglas D.C.8, Boeing 707, etc.

The Commando Hydrant Dispenser

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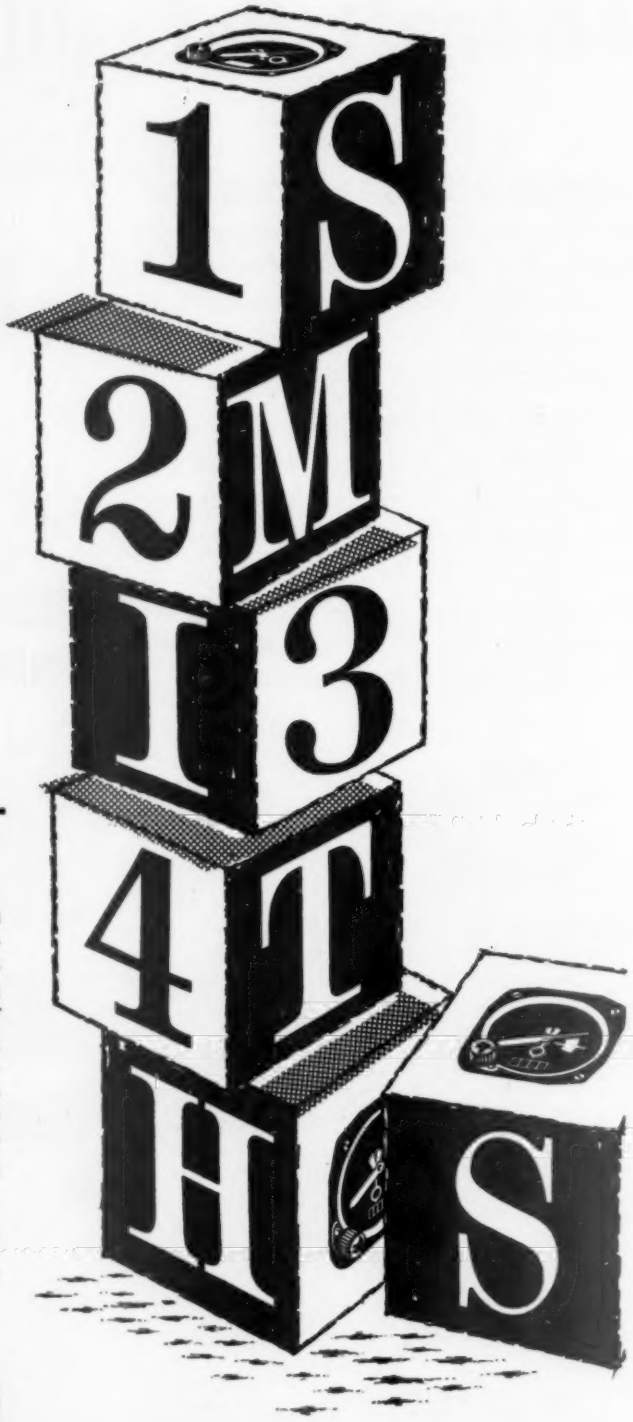

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Smiths Aviation Division is playing a vital part in the development of all-weather operation of aircraft. The latest advances in fully automatic landing will be on show at the Smiths stand at Farnborough, together with the full range of ignition accessories, fuel contents systems, flight, navigational and engine instruments and equipment, small motors, servos, synchros and gyro units—and the new ATR construction system for standard packaging of electronic and similar equipment. Make a note now to look us up on

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Silicon transistors provide maximum reliability. Weight, including aerials, is approximately 18 lb.

The STR40 Radio Altimeter together with many other STC Radio Navigation and Communications Equipments will be on the STC Stands 146-149 at the S.B.A.C. Exhibition, Farnborough.

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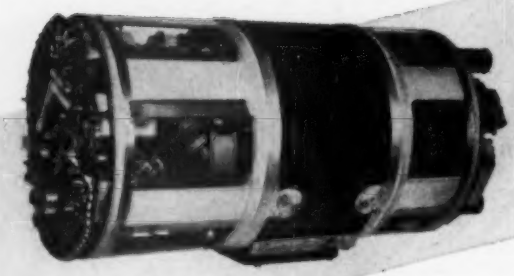
Aeronautical instrument design must needs keep ahead of aircraft development if advanced types are to give their best performance. The Brown Gyrotwin follows the now famous Brown Master Reference Gyro Mark 1 which was the first in the world. It is smaller and lighter and even more accurate. As before it transmits a stable reference point to pilots' instruments and remains undisturbed by aerobatic manoeuvres. Full technical information is available on request.

AND IT'S ALL BRITISH



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AIRCRAFT MASTER REFERENCE

More accurate–more compact–lighter in weight

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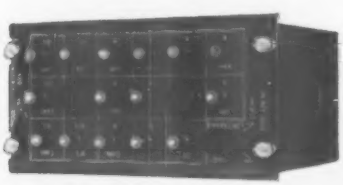
SOMETHING NEW AT THE SHOW

Visitors hope to see (and manufacturers strive to have) something "new" at the show. The combination of an extensive programme of electronic research and development, and a close association with the aircraft industry, enables Ultra Electronics Limited to provide new equipment to meet the requirements of every new advance in the design of aircraft. Two recent developments to be seen at Farnborough this year are illustrated below.

STAND No. 275

NEW COMMUNICATION CONTROL EQUIPMENT TYPE UA 60



Introducing push-button selection with volume control incorporated in push-buttons. This enables the station box to provide fifteen services on a panel less than six inches by three inches. Equally suitable for British and American installations. Tailored to specification.

NEW ENGINE CONDITION ANALYSER TYPE UE 91

This allows engine temperature and vibration conditions to be kept under continuous observation. The values can be assessed at a glance or measured accurately by means of the calibration arrangements provided. It gives immediate evidence of impending trouble.

A variant, Engine Vibrator Indicator Type UE 920, is also being shown. This instrument displays vibration information quantitatively on four moving-coil instruments. Excessive vibration operates warning lamp.

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Mixed Cargo/Personnel transport
Medical evacuation (24 litter patients)
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Supply dropping
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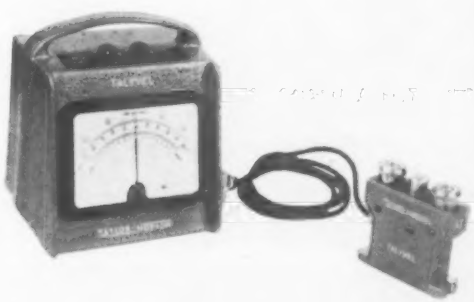

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THE AEROPLANE and ASTRONAUTICS

VOLUME 99 NUMBER 2550 SEPTEMBER 2, 1960

Farnborough Special

No issue of this weekly newspaper produced during the year contains more factual information than that devoted to the British Aircraft Industry and published on the eve of the S.B.A.C. Show at Farnborough. And here once again is just such an issue. Since the Show last year the Industry has completed a regrouping operation of some magnitude whereby the resources in design capability and in productive capacity have been organized in five major combinations. This year, as is only to be expected, the products on show are largely the result of work done before the regrouping and, in consequence, the exhibits will bear the names of their original producers.

In order to make understanding of the reorganization as easy as possible the section in this special issue devoted to the major aircraft and aero-engine constructors is prefaced by an account of what has taken place and is illustrated by an explanatory chart. This information is followed by material devoted to each group and its constituent companies. The products of each are illustrated and described in order of newness. Data have been arranged in tables at the end of the section. Thus the section on tinted paper forms in itself an illustrated guide to the reorganized industry and its products.

A preview of the exhibitors' stands comes next. In conclusion is a directory comprising the names and products of those members of the industry who are not exhibiting at Farnborough this year.

The issue contains all the regular features and, in addition, a comprehensive concluding report of the International Astronautical Conference at Stockholm.

Quite a lot of information for one week.

Vertical Lift

To many people a particularly significant feature of the forthcoming Show at Farnborough will be the appearance of the Short SC.1 Flat Riser, the VTOL machine which can lift itself horizontally into the air and then, converting itself into a conventional aircraft, go flying off at high speed with the ability to return to earth in the same apparently simple manner as it took off. Last year when it made its bow it had not completed the whole cycle of transition.

Vertical lift at Farnborough as such is no novelty. Helicopters and the Rotodyne have been demonstrating for some years one well-proved method of achieving this object with rotary wings. It was also a long time ago that the somewhat whimsically named Thrust Measuring Rig developed by Rolls-Royce showed that vertical lift was possible with gas turbines directing their efflux directly downwards, the whole stabilized automatically by air jets.

What is a matter of concern is that no steps have yet been taken by the Ministry of Aviation in furtherance of the possibilities of the VTOL engines installed in the Short SC.1. It is true that thanks to private enterprise an important step has been taken with the production of the Hawker P.1127 in which a somewhat different technique is to be used by deflecting the efflux of the horizontally installed propulsion engine.

On the other hand the German and French aircraft industries are pressing on with applications of the VTOL techniques made possible by powerplants from Derby. There is increasing concern over the delay in applying such units to VTOL weight-carriers.

Editor - - - THURSTAN JAMES
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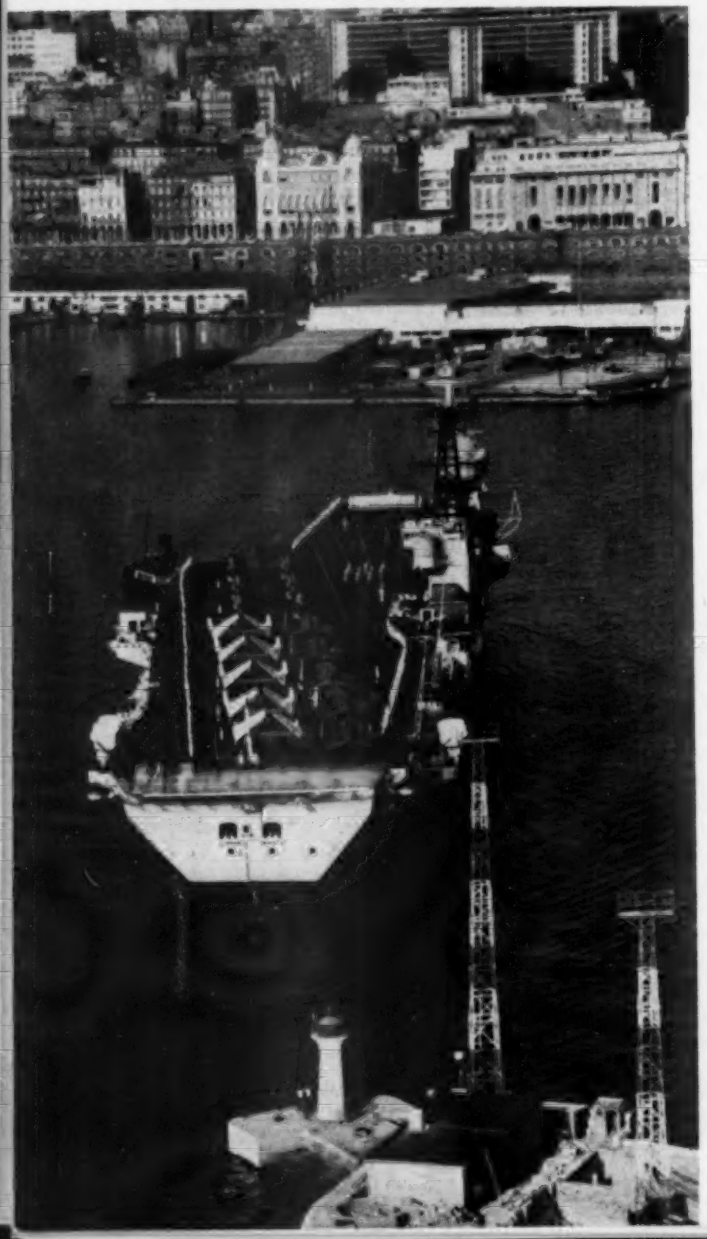
Matters of Moment

More Anglo-U.S. Links

SYMPTOMATIC of the growing interest among British aircraft manufacturers in the light aircraft market is the agreement concluded between Short Bros. and Harland, Ltd., and Beech Aircraft Corporation. Under the terms of this agreement, Short Brothers, in conjunction with Aircraft Associates, Ltd., will serve as distributors in the U.K. for the range of Beech light aircraft.

A service and maintenance organization, staffed by personnel trained by Beech at Wichita, is being set up by Shorts at their Rochester office. The Beech range at present comprises six types of aircraft—the single-engined Debonair and Bonanza and the twin-engined Travel Air, Twin Bonanza, Queen Air and Super G18. Under the terms of the agreement, Shorts may eventually assemble or manufacture any of these types if the demand makes this necessary.

Distribution of the Beech range will be one of the activities of Short's Light Aircraft Division, which is now developing the SC.7 Skyvan (see our previous issue, pp. 258a-259, and this issue, p. 273). The latter project is, in return, being studied by Beech and may be offered on the U.S. market by that company. The sales engineering activities in connection with the Skyvan will also be based on Rochester.



WORKING UP.—H.M.S. Hermes (Captain D. S. Tibbits D.S.C., R.N.) entering Algiers Harbour. Ranged on her flight deck are Sea Vixens, Scimitars and Whirlwind helicopters. The Hermes is working up in the Mediterranean.

As we have already reported, the new turbo-supercharged Continental engines for the Skyvan will probably be built in this country by Rolls-Royce, Ltd. Arrangements are also being made for the production over here of some other items of U.S. equipment which are specified for the Skyvan and de Havilland Propellers have acquired the franchise to sell and service the Hartzell propellers.

Co-operation in Space Research

SCIENTISTS of several Commonwealth countries met informally in London last week to discuss practical aspects of collaboration in space research. The conference, which lasted four days from Aug. 23 to 27, was convened by Sir Harrie Massey, chairman of the British National Committee on Space Research. Countries represented were Australia, Canada, Ghana, New Zealand, Nigeria, Rhodesia, South Africa, and the United Kingdom.

Object of the meeting, which opened at University College and continued at Burlington House, headquarters of the Royal Society, was to exchange ideas about ways of improving co-operation in such fields as satellite tracking and upper air research with sounding rockets.

Already, there is excellent working co-operation between the Australians and ourselves in research carried out with Skylark rockets at Woomera and, as Sir Harrie stressed at the recent I.A.F. Congress in Stockholm, it is necessary to obtain really comprehensive measurements of the atmosphere, below satellite altitudes, by means of small sounding rockets launched on a global scale. Co-operation between Commonwealth scientists would clearly be an important step in this direction.

Apart from Commonwealth discussions, Sir Harrie has also been busy seeking European co-operation. Earlier this year, he was appointed chairman of a five-man committee to prepare the groundwork for a European Space Research Centre. (THE AEROPLANE AND ASTRONAUTICS, Jly. 8, 1960, p. 31.)

He was elected at a meeting in Paris on Jne. 23-24 attended by scientists of 10 nations This followed a similar meeting in London at the Royal Society's headquarters last April. Objective of the Centre would be to establish co-operation in satellite tracking, high-altitude rockets and, eventually, artificial satellites.

Scientists are taking CERN, the European nuclear research organization, as a model for the proposed Space Centre. Its organizing secretary is, in fact, Prof. Auger of France—a founder-member of CERN. The other members of the committee are Dr. Broglio (Italy), Prof. Golay (Switzerland), and Prof. Hulthen (Sweden).

Nations represented at the discussions were: the United Kingdom, France, Western Germany, Belgium, the Netherlands, Norway, Denmark, Sweden, Switzerland, and Italy. Britain and France are, of course, already experienced in upper atmosphere research, and Sweden and Italy both have plans for high-altitude rocket programmes.

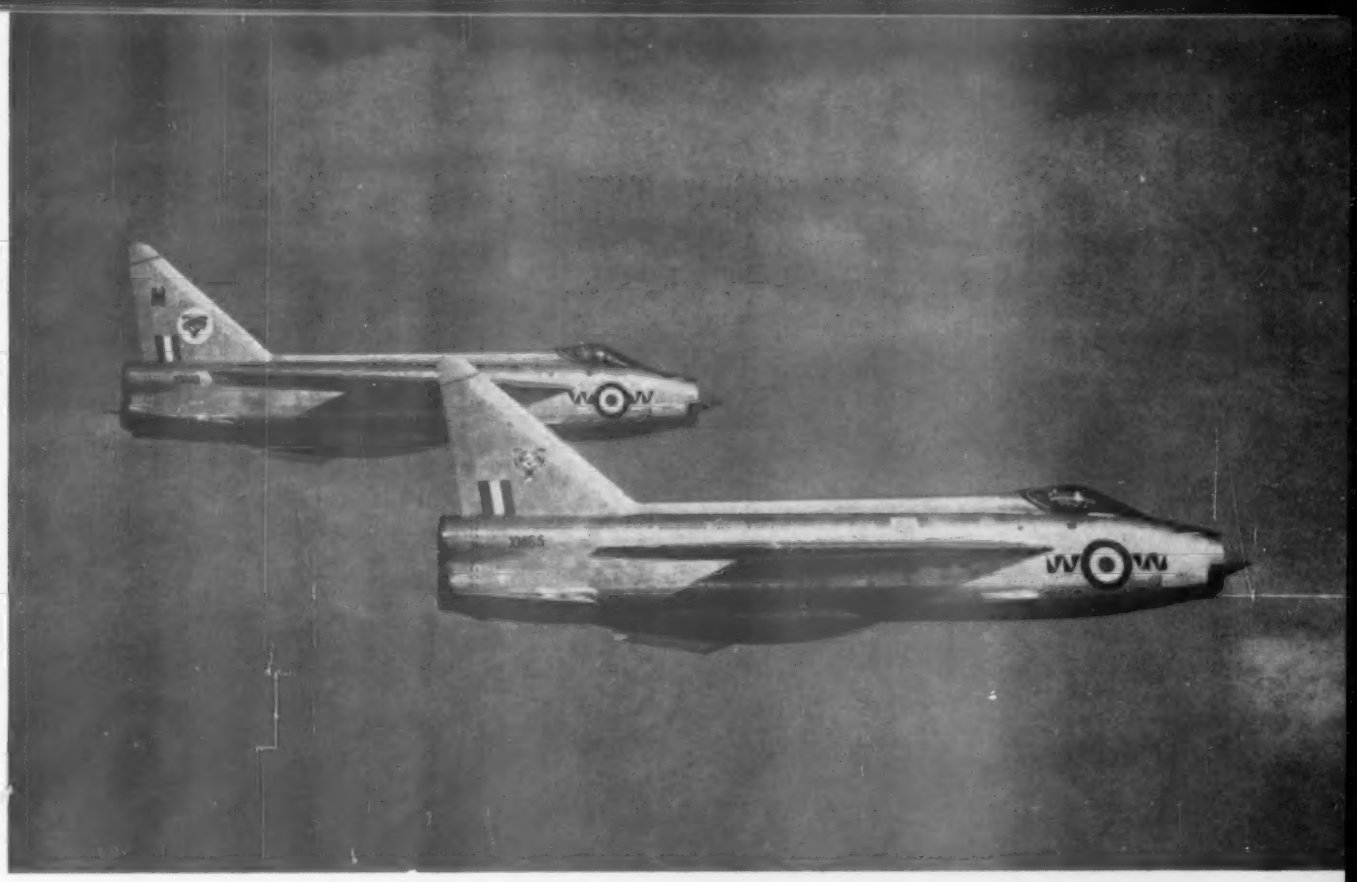
Clearly, the next step towards establishing the European Space Research Centre lies in obtaining the approval—and support—of the respective Governments.

Solving the Leader Cable Problem

AS most people are aware, one of the main difficulties in the operational application of the Blind Landing Experimental Unit's automatic landing system in its present form is the necessity for a leader cable ground installation. Providing azimuth guidance during the final approach from an approximate height of 300 ft. down to flare-out, this equipment consists of two cables situated about 250 ft. each side of the runway from approximately 5,000 ft. in front of the threshold point in the undershoot area to as far along the runway as azimuth guidance is required during the landing run.

To overcome this impossible installation problem at many of the potential airfields which could use the aid, B.L.E.U. is to evaluate two microwave guidance systems. The first, known as Leader Beacon, is produced by the radar and communications group of Elliott Brothers (London), Ltd., to a B.L.E.U. design and the second is the French A.S.V.23 system manufactured by Compagnie Générale de Télégraphie Sans Fil (C.S.F.).

Recently installed at R.A.E. Bedford, Leader Beacon consists of two small microwave transmitters and aerial systems located on either side of the runway approximately 2,000 ft. behind the touch-down point. The two aerials each radiate a 9° wide beam and these overlap approximately 1,000 ft. behind the runway threshold to form the azimuth guidance pattern.



ON THE PROWL.—First photograph of the English Electric Lightning in R.A.F. squadron markings, which are of No. 74 "Tiger" Squadron. This is based at Coltishall and is commanded by Sqn. Ldr. J. F. G. Howe.

Tilted up to the 3° glide path, this point-source radiation pattern has a range of 6,000 ft. or more from the touch-down point; it is about 50 ft. wide at a range of 200 ft. and approximately 200 ft. wide at 6,000 ft. The field set-up is similar to that produced by the magnetic leader cable system.

Leader Beacon is at present undergoing airborne measurement and development trials. It is hoped that it will be used for a complete automatic landing before the end of this year.

The C.S.F. system, which was designed by the French as an ILS replacement and provides both azimuth and glide path guidance, is not yet completely installed at Bedford. Although B.L.E.U. has already undertaken preliminary flying trials to evaluate an A.S.V. 23 installation in France.

Vigilant Order

AN order has been placed by the War Office for a batch of Vickers Vigilant wire-guided anti-tank misiles for infantry assessment trials. Vigilant has been developed as a private venture by Vickers-Armstrongs at a cost approaching £1 million; design work began in 1957 and the first firings were made the same year.

Vigilant can be carried by one man. It is launched from its carrying box and controlled by a hand-held sighting device. A velocity control system is used in which movements of the operator's thumb-tip change the heading of the missile; this technique is much easier to learn than the acceleration control normally used for wire-guided missiles. A small autopilot is installed in the missile to provide velocity control; it permits a small wingspan to be used, corrects for gust disturbances and gives consistent launching with automatic level-out.

The complete missile system weighs about 45 lb. Vigilant has a maximum range of 1,500 yd. and a minimum of 250 yd. with good lethality, although 50% hits have been scored at 180 yd. trials. The missile has a wingspan of only 11 in. and a speed of 450-500 ft./sec., higher than that of competitive missiles. Its hollow-charge warhead is considered effective against the heaviest tank.

At present the cost per missile is approximately £500, some 50% higher than for competitive anti-tank weapons, but if orders are received for thousands rather than hundreds of missiles the cost is expected to drop to £300 a missile. The British Aircraft Corporation is launching a campaign to sell Vigilants overseas.

The order from the British Army suggests a change of policy; in the past it has shown more interest in larger vehicle-borne missiles such as the Malkara and a Fairey missile whose development was cancelled. The infantry appear to have been neglected, but this will be remedied if Vigilants are ordered in quantity.

Echo Enters the Earth's Shadow

FOR the first time since its launching on Aug. 12, Echo 1 encountered darkness on Aug. 24. The communications satellite went into the Earth's shadow for about two minutes as it passed over Southern California at 5.24 a.m. (Wed.) EDT. The periods of darkness will increase with each pass until sometime in December when Echo will be in the Earth's shadow some 30 min. out of each 118-min. transit around the globe. Thereafter, the periods of darkness will diminish for the next three months.

The National Aeronautics and Space Administration issued special alerts to optical, radio and radar tracking facilities around the World urging maximum observation as Echo enters and emerges from periods of darkness. The purpose of this close observation is to try to maintain a precise determination of Echo's orbit.

Sublimating powders dusted into the sphere during folding prior to launch turn to gas at temperatures slightly above freezing. In continuous sunlight, the temperature of the sphere is about 240° F. Within a few minutes after passing into darkness, the temperature drops to about −80° F. and the gases return to a solid state.

Air Doctors Confer

TODAY, Friday, Sept. 2, is the last day of the 5th European Congress of Aviation Medicine held in London at the Royal College of Surgeons, Lincoln's Inn Fields. Previous Congresses have been held annually since 1956 in Holland, Sweden, Belgium and Italy consecutively. The forward-looking subject of this Congress was "Human Problems of Supersonic and Hypersonic Flight."

Lord Douglas of Kirtleside, for B.E.A., and Sir Matthew Slattery, for B.O.A.C., hosts to the Congress, greeted the guests on Monday, Aug. 29, and on Aug. 31 Dr. A. Buchanan Barbour, Director of B.E.A. Medical Services, welcomed delegates as Chairman of the Congress Organization Council at a special reception at Guildhall given by the Lord Mayor and Corporation of London.

Delegates from many countries presented papers covering all aspects of the Congress subject and also paid a visit to the R.A.F. Institute of Aviation Medicine at Farnborough.

Are we to Leave B.L.C. to the Americans?

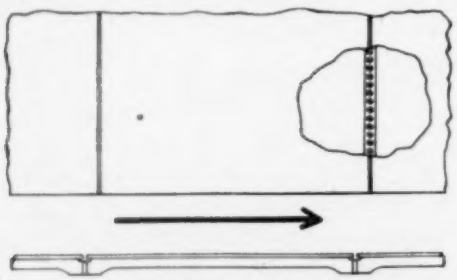
A model of the H.P. 117 all-wing design.

AFTER 10 years' intensive research the U.S.A.F. has, according to recent reports, satisfied itself that boundary layer control promises to make possible a major break-through as regards substantially increasing range and endurance without increasing the gross weight of an aeroplane. This increase in performance will come about through the very substantial reduction in drag achieved by the use of boundary layer control on the "wetted" surfaces of aircraft.

Such control is achieved by sucking away an appropriate proportion of air in the lower strata of the minutely thin "boundary" layer of air flowing over the surfaces of an aircraft in flight. This sucking maintains laminar flow and prevents the formation of turbulent flow. Wind-tunnel and flying tests have established that even when allowances have been made for the power required to suck the air away, a very substantial saving in the power required to propel the aircraft is achieved through the resultant reduction in drag and acceleration of air in the dead layer. In practice this saving of power is translated into increased range performance for a given payload.

The theoretical possibilities have been known for many years. For a long time small groups in this country have been working with very limited means, but though well aware of the possibilities they cannot obtain any substantial support to further their aims.

The latest news from the United States makes it clear that the U.S.A.F. is prepared to back its judgment in a substantial manner and to this end a contract has been placed with the Northrop Corporation of Beverly Hills, California, worth $20 million over three years. This money will enable Northrop to modify certain aeroplanes to incorporate completely "sucked" surfaces, not only it seems those of the wings and tail unit but also that of the fuselage. It is significant that work



Arrangement of the Northrop wing slits.

is to be put in hand on modifying two Douglas B-66 twin-jet bombers. These aircraft, as is well known, have swept wings, yet official belief in this country has been that boundary layer control of swept surfaces presented insuperable difficulties.

The American projects seem ambitious, for there is talk of modifying a Boeing KC-135 Strato-tanker. As the latter is the military version of the Boeing 707 this U.S.A.F. contract will ensure that the Boeing Company is well placed to incorporate any advantages in the Boeing 707. Obviously, incorporation of means to double the range for a given power and payload could revolutionize airline economics.

A great deal of practical flying work has already been done by Northrop in connection with boundary layer control to reduce drag. Some interesting figures were given in our issue of May 13 last on p. 580. In a specially written article on "Trends in Laminar Flow Research," Dr. Ing. Gustav Lachmann, F.R.Ae.S., included an account of an impromptu lecture given before an Agard meeting in London last April. The lecturer was Dr. Pfenniger who has been head of a very active team at Northrop investigating this subject for some years.

In his talk Dr. Pfenniger produced illustrations of the means used to suck away the boundary layer and gave results of full-scale flying tests and of model tests with sucked swept wings. The full-scale tests were made with an F-94, a two-seat Lockheed all-weather fighter with a straight wing. A "glove" had been fitted to the wing and in the surface of this a number of slits parallel to the span of the wing had been cut. The passage of air was controlled by the size of the small holes drilled in the channel beneath each slit and feeding to the suction duct.

Laminar flow over the whole chord of the wing was achieved up to the test limiting speed. The results were equivalent to laminar flow over a wing of 35.7 ft. chord operating at a Mach number of .85 at 50,000 ft. Full-chord laminar flow was constantly maintained in horizontal flight, climb, descent, banked turns (up to 60° bank angle) and in moderately gusty weather. During a flight from Fort Muroc, in California, to Dayton, full-chord laminar flow was maintained throughout the flight. Rain caused transition; however, full-chord laminar flow was re-established after passing through the rain cloud. Completely laminar flow could also be maintained with increased speed until a local Mach number of 1.08 was exceeded.

In contrast with these achievements, Dr. Lachmann in his article pointed out that in this country, following work at the R.A.E. in 1952, the conclusion was reached, theoretically, that excessive suction would be required to stabilize full-chord laminar flow on a swept wing. Dr. Lachmann observed: "Thus, further research on B.L.C., either in the theoretical or experimental field, was stopped at R.A.E. In fact, interest in laminar flow was buried with almost indecent haste which reflected strongly on Ministerial policy."

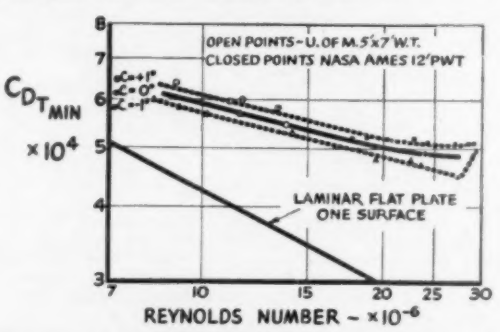
However, in spite of official reluctance to admit the potentialities of suction control of the boundary layer, the enthusiasts persist in their efforts. At Cambridge work is being done with the aid of an Auster modified by Marshalls of Cambridge to establish the effect of boundary layer suction on the increase of lift.

Following flight tests made several years ago with a Vampire fitted with a laminarized glove on one wing, Handley Page have now built a completely laminarized wing, a little larger than that of the Gnat, and swept to 40°, which is to be mounted on the top of a Lancaster fuselage. The air is to be sucked away by coupling the ducts to the intakes of the pair of Butterworth industrial gas turbines. It will be tested at the College of Aeronautics at Cranfield in collaboration with Handley Page Research Department.

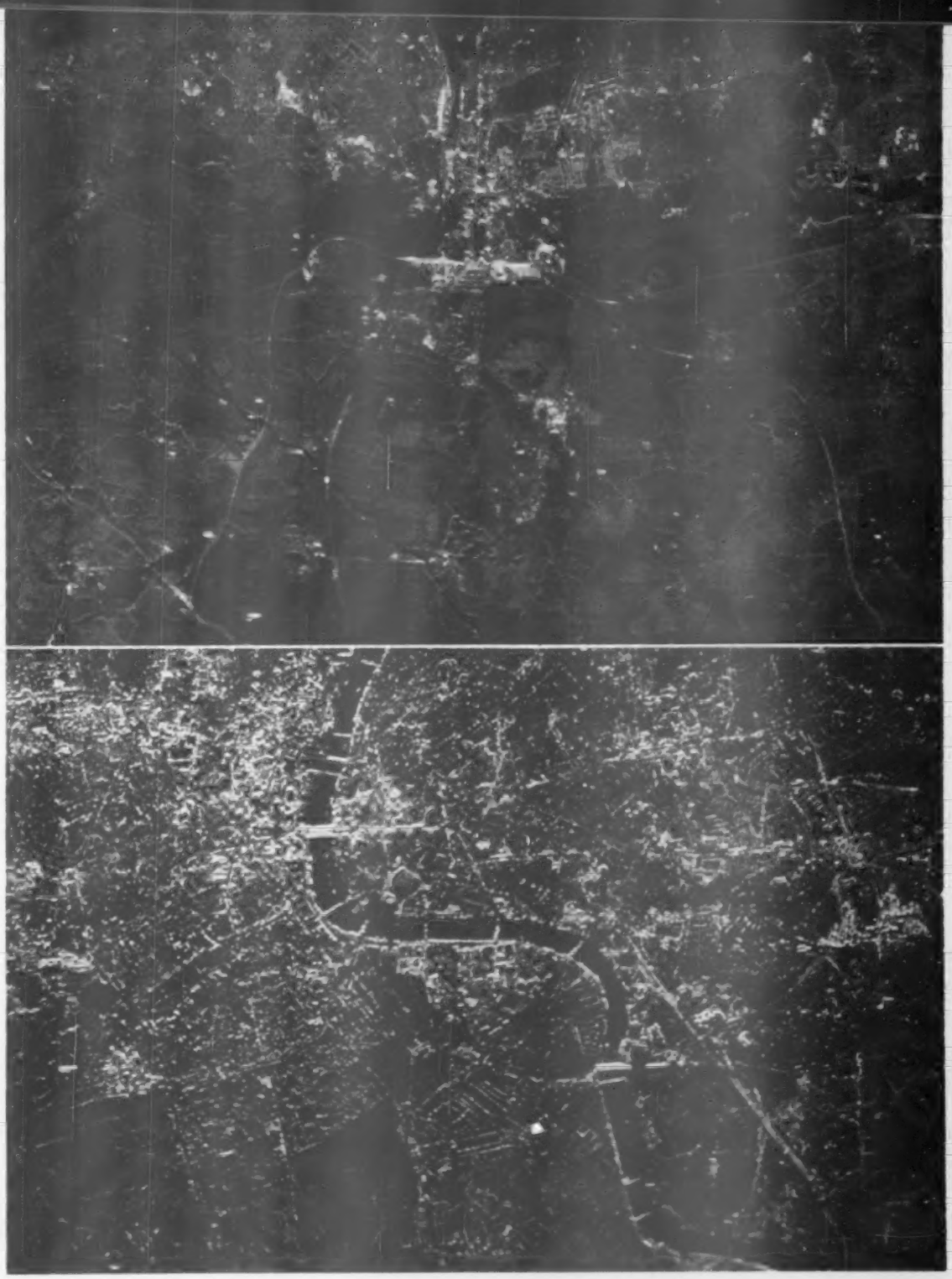
The practical possibilities are vividly emphasized by information which is to be featured on the Handley Page stand at Farnborough. This shows what could be achieved with the projected H.P. 117 300-passenger all-wing airliner. In this machine transatlantic fares per head to cover operating costs and 100% overhead charges could be as low as £11 per head—at 100% load factor. But this is an all-wing design and as such must be some years away.

The significance of the decision by the U.S.A.F. is that within three years Northrop are to have flying swept-wing, high-performance bombers with fully laminarized flow. The successful outcome of this work may well lead to similar development of the Boeing KC-135.

Surely the time has come for the research establishments in this country to press on much more vigorously with research into boundary layer control. What is clearly wanted is full-scale study of its application to swept-wing designs typical of current development. One wonders whether a Javelin might not be spared for some useful work here.—T.J.



Minimum profile drag coefficients of 30° swept laminar suction model. One surface.



ALL-SEEING EYE

TOPIC of much current interest concerns the ability of an air force to obtain reconnaissance photographs of foreign territory. Since the use of H_2S radar in the last war much progress has been made. The photographs on this page are typical of those obtained by Victor bombers of the R.A.F. with their radar equipment through thick cloud, in fog and at night without artificial lighting.

That at the top is of Northampton and the surrounding countryside. M1 is the conspicuous black streak flowing from N.W. to S.E. down the left-hand side of the picture. Cars on it, fly-overs and fly-unders, are identifiable. Railways in and out of the city are clear. The lower view, showing London, at first sight is even easier to make out. In closer examination one has to recall that radar reflections from buildings are "specular" and "aspect conscious." For this reason one or two well-known features may not be identified. Some grassy spaces appear to be water-covered.

Aviation News in General

U-2 ECHO.—By way of confirmation of doubts expressed at the end of the summary of the U-2 evidence in last week's issue (p. 239), a report from the U.S. last week quoted Mr. Powers, Sen., as saying that his son had told him that he did not believe that his aircraft had been shot down, but would not elaborate on this statement.

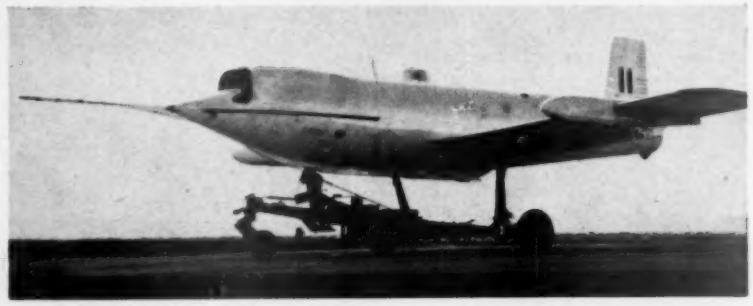
MORE SEA VIXENS.—A second reorder for Sea Vixens has been announced by de Havilland. This Naval all-weather twin-Avon fighter was first ordered in quantity in January, 1955, and a further order was announced in June, 1959. The total quantity now on order is understood to exceed 100.

EGYPTIAN JET.—The first Egyptian jet aeroplane, which made its first flight a few weeks ago, is, we understand, a locally assembled example of the Spanish Hispano HA-200 Saeta jet trainer. The HA-200, designed by Willi Messerschmitt, is powered by two Turboméca Marboré turbojets.

GIRHEL ACCIDENT.—The prototype Girhel autogyro, exhibited by Helicop-Air at the 1959 Paris Aero Show, was damaged on Jly. 13 while landing at Villaroche aerodrome, Melun, near Paris. A sudden gust of wind caused it to crash; the extent of the damage has not been reported.

NUCLEAR DEPTH CHARGE.—Intended for delivery by helicopter and aircraft, the U.S. anti-submarine forces' new atomic depth charge, "Lulu," is a lighter and smaller anti-submarine weapon than the U.S. Navy's first nuclear depth charge, "Betty," which it will eventually replace.

NATO CONTRACT.—De Havilland Propellers have received a contract for propeller equipment for the prototype Breguet 1150 Atlantic, the new maritime reconnaissance aircraft for NATO air forces. Powered by two Rolls-Royce Tynes the Atlantic is due to fly in 1961.



TARGET AIRCRAFT.—A new photograph of the Jindivik Mk. 2B pilotless target aircraft. Similar to the earlier Mk. 2, it is powered by a Viper ASV.8 turbojet.

NO COMMENT.—At a Press conference in Stockholm, following the launching of the dog-carrying Sputnik V, Prof. Blagonravov declined to say whether the re-entry technique was purely ballistic or partially aerodynamic prior to parachute deployment.

SPACE MUSIC.—A few bars of brass band music have been relayed across the Atlantic using the Echo balloon satellite as a reflector for radio signals. Receiving antenna was the Jodrell Bank radio-telescope.

SPUTNIK AID?—Prof. A. C. B. Lovell, director of the Jodrell Bank Experimental Station, has asked the U.S.S.R. Academy of Sciences to consider the possibility of launching a small British-built radio-telescope device in a future sputnik. Object is to investigate low-frequency waves which do not reach the Earth's surface. American satellites, he said, could carry the equipment but these "were packed for some years ahead."

SOFT LANDER.—The 85-lb. instrument packages ejected from the 300-lb. re-entry capsules of Discoverers XIII and XIV (THE AEROPLANE AND ASTRONAUTICS, Aug. 26, p. 235) were recovered using parachute systems designed and manufactured by Irving Air Chute Company in conjunction with Lockheed Aircraft and General Electric. The Lockheed company produces the Agena satellite and General Electric the capsule.

PRECISE HOUND DOG.—Operational trials of the North American GAM-77A Hound Dog air-to-surface missile from B-52G bombers are proceeding satisfactorily. A recent missile is said to have "impacted with extreme accuracy" after a 500-mile flight.

SOLAR-PUSH.—The minute pressure of sunlight is forcing the 80-lb., 100-ft.-dia. balloon-satellite Echo steadily towards the Earth's atmosphere and ultimate destruction. Although solar radiation pressure at 1,000 miles altitude is only one ten-millionth lb./sq. ft., it is sufficient to shift the orbit 2.2 miles closer to Earth each day at perigee.

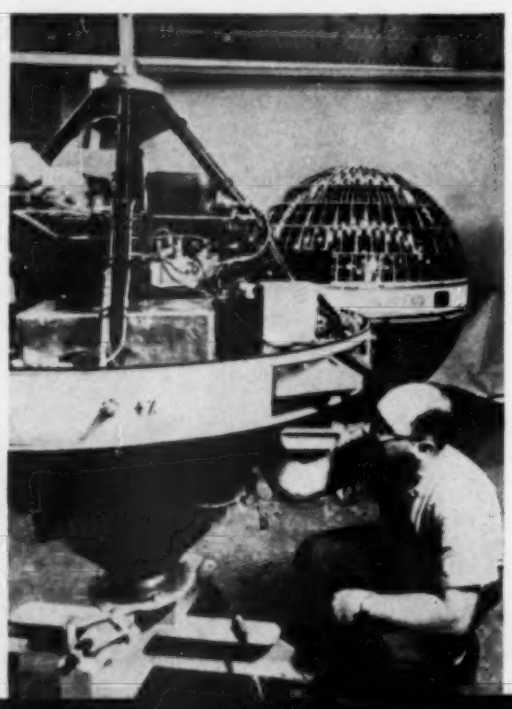
FAIREY APPOINTMENT. — Mr. G. C. Roberts has joined the board of Fairey Engineering, Ltd., at Heston, as commercial director. Until recently he was managing director of Britvic, Ltd., and its subsidiary companies and a director of Vine Products, Ltd.; he will continue to be chairman of E. and H. P. Smith, Ltd.

HONOURED.—Well-known in the British aircraft industry, Capt. John Jay Ide, U.S.N.R., has been awarded the cross of Chevalier of the Legion of Honour by the French Government. Capt. Ide served in London after the end of World War II as the Assistant Naval Attaché for Air. He has been a delegate since 1922 to the conferences of the F.A.I. of which he is a vice-president.

SIKORSKY APPOINTMENT. — Mr. Carlos C. Wood, director of advanced engineering planning for Douglas Aircraft Co., joined Sikorsky Aircraft on Sept. 1. He will succeed Mr. Michael E. Gluhareff as engineering manager when the latter retires on Oct. 1. Mr. Wood had been with Douglas for 23 years.

DOUGLAS NEWS. — Schuyler Kleinhans has been named director of advanced research at Douglas Aircraft; he joined the company as a project engineer in 1933, and has been assistant chief engineer and chief engineer. Charles R. Strang becomes chief engineer—transport aircraft engineering; until early this year he was chief engineer of the company's Tulsa, Oklahoma, division.

(*More news on page 271*)



SPACE-REPEATER.—First picture of the Courier satellite designed to receive and relay tape-stored messages from space. It is equipped with 300 lb. of electronic equipment and tape-recorders which enable it to receive 340,000 words of coded information in a five-minute pass over a receiving station. Outer casing is covered with solar cells which will produce electricity directly from sunlight.

BRITISH AIRCRAFT CORPORATION

Incorporating the
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of the following companies :

This 600 m.p.h. aircraft has been developed from the standard VC10 to meet the future needs of airlines operating on the high density and expanding trunk routes. With its extended fuselage and uprated Conways the Super VC10 will carry up to 212 passengers or a total payload of 58,000 lb.
VICKERS
Super VC10
LONG

BRITISH
AIRCRAFT
CORPORATION

the next logical advance in air transport

SHORT & MEDIUM HAUL

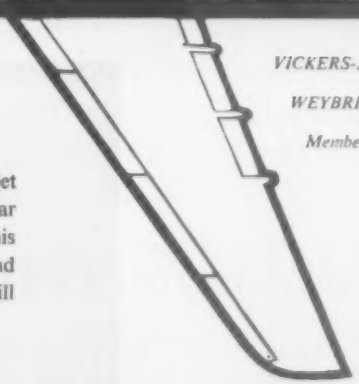
VICKERS VANGUARD

The turbo-prop Vanguard is the aircraft to take advantage of fast growing traffic. Four Rolls-Royce Tynes provide a cruising speed of 420 m.p.h. with a payload of up to 37,000 lb. Unrivalled operational economy, flexibility and low initial cost make it the most profitable aircraft ever offered to the airlines.

HAUL

VICKERS VC10

The VC10 is the world's most advanced long haul jet airliner in production now. The clean wing and rear mounted Rolls-Royce Conway engines will give this aircraft exceptional airfield performance and all-round operational superiority. This 'New Look' airliner will carry 150 passengers in quiet comfort at 600 m.p.h.



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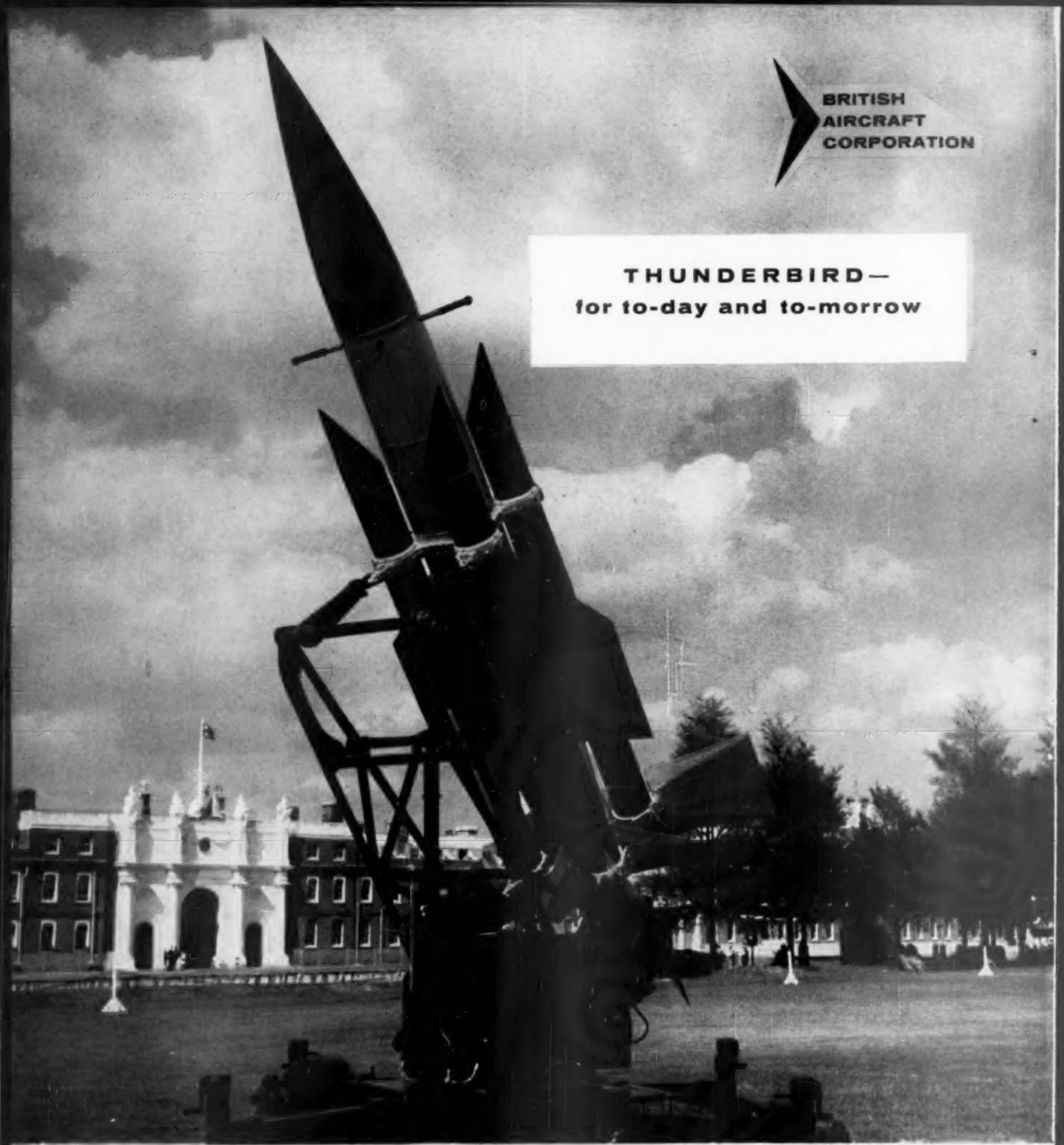
TGA AT480



The English Electric Thunderbird is Britain's mobile anti-aircraft weapon system and is in service with the British Army.

An even more advanced version of the Thunderbird is now completing its development. Employing advanced techniques and retaining its full mobility the new version will provide, among other advantages, better performance against low level attack and increased range.

'ENGLISH ELECTRIC' THUNDERBIRD

ENGLISH ELECTRIC AVIATION LTD · *GUIDED WEAPONS DIVISION* · LUTON · STEVENAGE · WOOMERA

MEMBER COMPANY OF BRITISH AIRCRAFT CORPORATION

GW.196

The English Electric all-weather day and night interceptor, one of the most advanced aircraft in the world, is the fastest British aircraft in production, capable of flying at more than twice the speed of sound. The Lightning has been ordered for the Royal Air Force in substantial quantities and is now in service.

'ENGLISH ELECTRIC' *Lightning*

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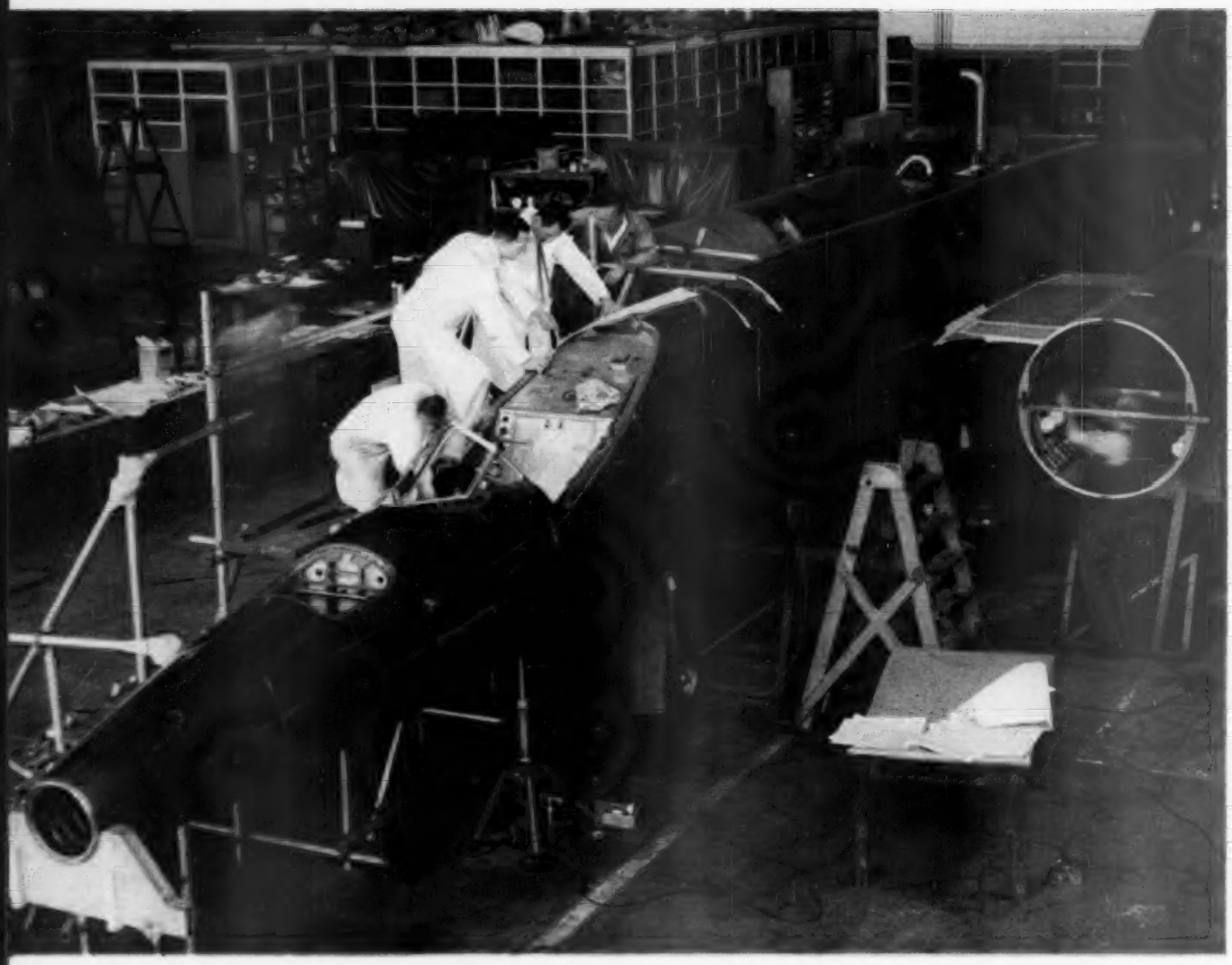

HIGH-SPEED RESEARCH

Bristol have been in the business of building aeroplanes for over fifty years. During that time they have achieved many unique advances in the design and development of fighters, bombers and civil and military transports. Today, Bristol Aircraft Limited are firmly established as one of the foremost constructors of high-performance aircraft and missiles.

Two Bristol products, the Type 188 research aircraft, and the Bloodhound guided missile, forcibly demonstrate how well the Company is equipped to satisfy the needs of aviation—in the present and in the future.

THE MOST ADVANCED AIRCRAFT STRUCTURE IN THE WORLD

A single-seat aircraft powered by two De Havilland Gyron Junior turbojets, the Type 188 is made of welded stainless steel and is the most advanced structure of its kind in the world. Designed for speeds well in excess of 1,500 mph, the Type 188 will investigate problems of kinetic heating, structural stresses and shock-wave formation associated with high supersonic flight.

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THE WEST'S MOST ADVANCED-PERFORMANCE DEFENCE AGAINST AIR ATTACK

The Bristol/Ferranti Bloodhound Guided Weapon System, ordered by Britain, Sweden and Australia, provides the West with its highest-performance defence against air attack. Designed for operational flexibility, the system employs a unique aerodynamic configuration and advanced Bristol Siddeley ramjets which enable it to intercept any known manned aircraft in service.

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BRISTOL — BUILDING FOR THE FUTURE OF FLIGHT

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JET PROVOST

Powered by one Bristol Siddeley Viper turbo-jet. The Jet Provost T.Mk. 3. is now in regular service at Royal Air Force Flying Schools and will be supplemented during 1961 by the T.Mk. 4 of substantially increased performance

MEMBER COMPANY OF
BRITISH AIRCRAFT
CORPORATION

HUNTING AIRCRAFT LIMITED
LUTON AIRPORT, BEDFORDSHIRE, ENGLAND

Commercial Aviation Affairs

A NEW B.C.A.R.—Issue 5 of Section A of the British Civil Airworthiness Requirements, covering general information and procedure, has now been issued by the A.R.B. and has been effective from Aug. 15, on which date the Air Navigation Order, 1960, came into effect. Section A has been extensively rewritten to conform with the new A.N.O., although many of the revisions are of a detailed nature. In future, certificates of airworthiness will be issued in five categories as follows: transport (passengers), transport (cargo), aerial work, private and special.

VISCOUNT REGULARITY.—Latest available figures for the regularity of aircraft operated by U.S. domestic airlines show the Viscount in the first three places. The percentages of arrivals within 15 min. of schedule were Continental 75.2, Capital 74.1 and Northeast, 73.9.

CUNARD-EAGLE EQUIPMENT.—Cunard-Eagle Airways is reported to be planning the purchase of three Viscounts for use on its European services. The group at present has two Viscount 707s used by the Bahamas and Bermuda companies. Cunard-Eagle is also expected to buy the Britannia 318 which is at present chartered from Cubana.

JUNE MOVEMENTS.—M.o.A. figures for June show an increase of 3% in the total number of movements and 14.3% in air transport movements at U.K. aerodromes, compared with June, 1959. Other increases for the month were passengers (including transit) 28.6%; freight set down and picked up 22.3% and mail 8.8%. In the first half of 1960, air transport movements increased by 17%, passenger traffic by 30% and freight traffic by 37%.

CUBAN SALE.—Cubana is reported to have been authorized by the Cuban treasury to sell two Viscounts and three Super Constellations, together with other equipment having a total value of nearly £750,000. The Viscounts are presumably the two 755s which have been in service with Cubana since 1956; the airline also has three Viscount 818s.

GHANA U.A.R. PACT.—An air agreement between Ghana and United Arab Republic covering reciprocal landing rights has been signed in Accra. A similar agreement is being negotiated between Ghana and the Lebanon.

CAPITAL LOSS.—In the first six months of this year Capital Airlines recorded a net loss of $7,108,739. This loss compares with that of $624,636 for the first half of 1959.

MORE CONTROL.—The "floor" of the continental control area over the U.S. will be lowered from 24,000 ft. to 14,500 ft. on Oct. 13 if an F.A.A. proposal is confirmed. In the continental control area, IFR must be used when the in-flight visibility is less than five miles and when pilots are unable to maintain 1,000-ft. vertical and 1-mile horizontal separation from clouds. Above these minima, IFR or VFR can be used.

NO CIVIL HERCULES.—Lockheed Aircraft is reported to have abandoned plans to market a commercial version of the C-130B Hercules freighter. This apparently follows the failure of Zantop Air Transport to finance its proposed order for five Hercules required for a Logair contract (see our issue for Jly. 15).

AIR TRANSPORT COURSE. — A special air transport course is being held by the Royal Aeronautical Society at Oriel College, Oxford, from Aug. 25 to Sept. 3 for the benefit of 14 students from the Colonial Office and various British colonies. The course is a shortened version of that held annually for the past five years by the Society during the Easter vacation.

NEAR MISS AT MAURITIUS.—A Qantas Super Constellation was destroyed at Plaisance Airport, Mauritius, on Aug. 24 after an engine failed during take-off. The aircraft skidded off the wet runway, hit an obstruction and caught fire. Six of the 38 passengers were slightly injured.

DON EVERALL LOSS.—A Don Everall (Aviation), Viking on a charter flight from Brindisi to Cairo crashed shortly after taking off from Heraklion, Crete, on Aug. 24. The crew of three were killed.

The Farnborough Show

ON Monday, Sept. 5, the 21st Flying Display and Static Exhibition of the Society of British Aircraft Constructors opens at Farnborough. Elsewhere in this special issue of THE AEROPLANE AND ASTRONAUTICS are detailed notes and illustrations of the aircraft, engines and equipment displayed at this Show.

The display and exhibition starts on Monday, with a Press preview and technicians' day, the opening proper being on Tuesday—the first of three private trade days. On all four days the Show will open at 09.30 hrs. and close at 18.00 hrs. Aircraft will be available for inspection on the ground each morning and a flying demonstration will be given in the afternoon starting at 14.30 hrs. On these days admission is by invitation.

HOW TO GET THERE

On the public days Friday, Saturday and Sunday, Sept. 9, 10 and 11, the gates will open at 10.00 hrs., and the flying programme will start at 15.00 hrs. The entrance fee will be £1 on the Friday (plus £1 for car parking) and 5s. on the Saturday and Sunday. Car park fees at the week-end will be 30s. for a car (including up to six occupants), 2s. 6d. for a motorcycle and 1s. for a bicycle.

On the three public days British Railways are offering a cheap combined rail and coach fare costing 10s. return between Waterloo and Farnborough via Aldershot. Trains leave Waterloo at 27 and 57 minutes past each hour.

WHAT TO SEE

Among the large number of aircraft of all types to be seen either on the ground or in the air, will be the new Avro 748 Dart-powered feeder-liner making its first public display appearance. Another display highlight is the Short SC.1 flat-riser experimental VTOL aircraft which will demonstrate its remarkable transition from hovering to horizontal flight. Among the helicopters, Westland's Westminster is to be seen with its interesting experimental faired fuselage.

In the flying display something well worth looking out for is a demonstration, by two de Havilland Sea Vixens, of the technique of "buddy" refuelling. Britain's first stand-off bomb, the Avro Blue Steel, makes its début in the guided-missile section. And in the main static exhibition marquee, a powerplant worthy of close study is the new Bristol Siddeley BS.53 turbojet for military VTOL applications such as the Hawker 1127 NATO fighter.

An interesting additional item in the flying display programme on the three public days is some sailplaning by the R.A.E. Aero Club's gliding section. These demonstrations will be given from 13.00 hrs. to 13.45 hrs. on each of the three days and will comprise aerobatic displays with Slingsby and Elliotts sailplanes. Some of the craft are to be equipped with Pye glider communications radio which will be linked into the public address system so that the pilots can give their own commentaries. The sailplanes will be aero-towed in pairs by Auster tugs and will be flown by members of the R.A.E. gliding club and by other eminent sailplane pilots.

V-Bomber "Scramble"

Participation by the Royal Air Force involves seven types of aircraft. An innovation this year will be a "scramble" by the three V-bomber types. Different squadrons, each providing four aircraft, will operate on different days.

These comprise No. 148 Squadron (Wg. Cdr. D. C. Lowe, D.F.C., A.F.C.) equipped with the Vickers Valiant at Marham; No. 617 Squadron (Wg. Cdr. L. G. A. Bastard, A.F.C.) flying the Avro Vulcan and based at Scampton; and No. 15 Squadron (Wg. Cdr. J. G. Matthews, A.F.C.) from Cottesmore and operating the Handley Page Victor. Crews will be in position in their aircraft on the runway and on a given signal engines will be started simultaneously and the V-bombers will take off.

Other features of the R.A.F. display will be a fly-past of four English Electric Lightning F.1s from No. 74 Squadron (Sqn. Ldr. J. F. G. Howe) from Coltishall and the No. 111 Squadron (Sqn. Ldr. P. A. Latham, A.F.C.) aerobatic team which is based at Wattisham. Taking off from Farnborough, the Treble-One team is putting up 18 Hawker Hunter F.6s for a nine-minute display of co-ordinated aerobatics.

Flying Training Command is providing the Central Flying School aerobatic team of four Hunting Jet Provost T.3s led by Flt. Lt. R. Langstaff. A demonstration of the long-range capability of Coastal Command will be made by No. 201 Squadron (Wg. Cdr. A. C. Davis) operating Avro Shackleton MR.3s from St. Mawgan. An aircraft will take off towards the end of each day's display and return to Farnborough at the beginning of the next day's show, having been airborne for over 20 hr., participating in a NATO exercise.

Air Transport

Thoughts on the B.E.A. Report

ONE thing about B.E.A.'s good results for 1959-60 (see last week's issue p. 240) seems to stand out as a lesson for all airlines. Improved World economic conditions and good organization notwithstanding, the major reason for the Corporation's comparatively big profit is undoubtedly the fact that the airline was operating a fleet of well-proven and still-competitive aircraft over an established network. In short, there were no operational set-backs.

The point was underlined, both in the Report and at the Press conference coinciding with its publication, by warnings about over-zealous re-equipment policies and, in particular, about any supersonic scramble. At the conference Lord Douglas said, in effect, that airlines would stay solvent only if they allowed a reasonable period (of, say, 10-15 years) for writing-off the units in their fleets.

Some idea of the effects of the long-term use of aircraft can be gained from the breakdown of aircraft costs which are among the many helpfully detailed statistical tabulations in B.E.A.'s annual report—which must be more complete than those for any other transport or industrial undertaking. In the Report for 1958-59 the overall cost for the Viscount worked out at 41.3d. per capacity ton-mile and 4.5d. per seat-mile; in the current report the same aircraft type was shown as costing, overall, 37.9d. per C.T.M. and 4.1d. per seat-mile.

Of the net profit for 1959-60, totalling £2,086,078 (plus a credit balance of £29,780 from the previous year), a sum of £80,533 was carried forward and the remainder was used primarily to increase existing reserve funds and to institute a new reserve. A sum of £1,000,000, for instance, was used to start a development reserve to cover unforeseen expenditure on new aircraft. Such expenditure will thus not necessarily need to be written off in the operating accounts of future years—which may, perhaps, be leaner than 1959-60. The general reserve was increased by £150,000 to £500,000 and the insurance reserve by £500,000 to a figure of £1,359,543. Additionally, "intangible assets" of £385,325 (consisting in effect, of the debt remaining from acquisition of shares in the original A.A.J.C. companies) were written off.

The Future

B.E.A.'s general views about supersonic transports have been outlined in the second paragraph. The Corporation's official position is that it sees no supersonic requirement for short-medium-haul operations since any time-saving will be negligible, but appreciates the fact that there may be competitive pressure from long-haul service extensions within Europe when and if the supersonic aircraft come into service on the North Atlantic.

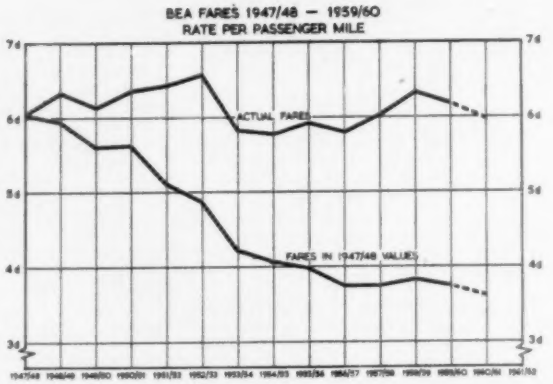
Time can be more usefully saved for B.E.A. passengers by city-centre helicopter-type operations for short-haul services, and by city-to-airport rail links to speed up medium-haul fixed-wing services.

The future of the Rotodyne for B.E.A. depends on a reduction of noise level or a statement by the Ministry of Aviation to the effect that the level of noise expected with the more powerful Tyne-engined development for B.E.A. will be acceptable for city centre operations. If it cannot be used for these services, then the aircraft is of no value to B.E.A., which would nevertheless be prepared to go on with a development and purchasing programme if it were to be agreed that the military would take the aircraft over if city centre operations proved, in practice, to be impossible.

Meanwhile, there is the prospect that 25-seater Bristol 192s, Sikorsky S-61s, or Vertol 107s might be used on the Land's End-Scilly Islands service. If the Ministry were to close the two airports used for this service and give B.E.A. the annual sum which would be saved (about £45,000) a lot of useful work could be done during a three-year period of experimental helicopter operations between, say, Penzance and St. Mary's.

At present this useful little service is operated with D.H. Rapides—which, as 6-7-seaters flying up to 25 services a day, are uneconomic. With such small units the flight crew costs alone are prohibitive; according to the breakdowns in the Report, the flying staff proportion of the hourly cruising costs of the Rapide stands at more than one-third of the total by comparison with a figure of less than one-fifth in the case, for instance, of the Viscount 802. The overall cost of B.E.A.'s Rapides works out at 11.6d. per seat-mile.

By the end of next winter, incidentally, all the DC-3s except the seven freighters will have been withdrawn from service and replaced by Viscounts.



The present shortage of capacity on the domestic trunk routes will be dealt with by the introduction next summer of Vanguards on the London-Belfast, -Edinburgh and -Glasgow services. The use of such 130-seaters might eventually permit a system whereby passengers simply go to the airport and step aboard as and when a seat is available. The Vanguard, which is worth about £4,000 a day in revenue on the Paris run, will be in full operational use by March, 1961, and will be in unplanned service before the end of this year.

The L.A.P. Central Area traffic congestion problem is a very serious one—and will, no doubt, be much worse when the long-haul building is in operation. At times, during peak periods, queues of passengers' cars have extended back to the tunnel. More use of Gatwick will help to reduce congestion, but there are obvious inter-line transfer difficulties with the use of two airports, and B.E.A.'s engineering base is at L.A.P. Nevertheless if foreign operators are ready to use Gatwick for parallel operations, B.E.A. will be prepared to base more services there.

By way of postscript it might be noted that the profit for the year (after paying interest on capital and advances at an average rate of 4.6%) works out at about 3.2% of the total value of the Corporation's assets. So it may not be unreasonable to suppose that, as a normally financed business, B.E.A. might have paid a dividend of about 3% to its stockholders.—H.A.T.

Improving the 707

AN increase of at least 10,000 lb. in the permissible take-off weight at Johannesburg of South African Airway's Boeing 707-344s is expected to result from the adoption of full-span leading-edge flaps. The third of the three Boeing 707-344s will be delivered with these flaps next January and the other two will return to Seattle for modification next year. The installation comprises flaps in three sections—outboard, between, and inboard of the engine pylons. This arrangement is similar to that on the Boeing 720; standard installation on the 707-320 and 707-420 involves the use of two flap sections on each wing.

Another gain in performance on the third S.A.A. 707 will come from the use of 17,500 lb.s.t. JT4A-12 turbojets in place of the 16,800 lb. A-9 engines of the first two. By use of titanium in the compressor section, the A-12 engine is some 200 lb. lighter than the A-9, which increases the payload by the equivalent of four passengers.

As a result of these improvements, S.A.A. expects to minimize the effects of Ghana's decision—which may be copied by other newly independent African states—to deny landing rights to S.A.A. Non-stop service to European terminals would be possible at some expense to payload, but S.A.A. is planning at present to route one service a week through Brazzaville and the other three through Salisbury and Nairobi (see our issue for Aug. 19, p. 211).

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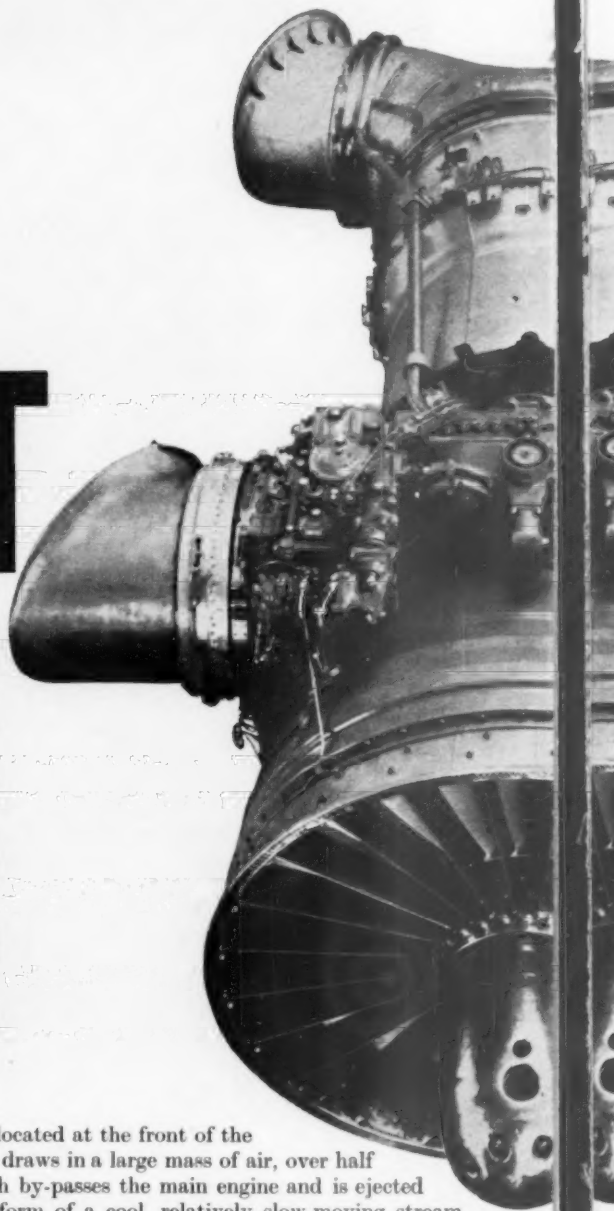


A single power source for VTOL and STOL aircraft. The new Bristol Siddeley BS 53 high-ratio turbofan represents a major engineering breakthrough in the field of VTOL and STOL aircraft propulsion because it provides the airframe designer with a single power source *for all conditions of flight*.

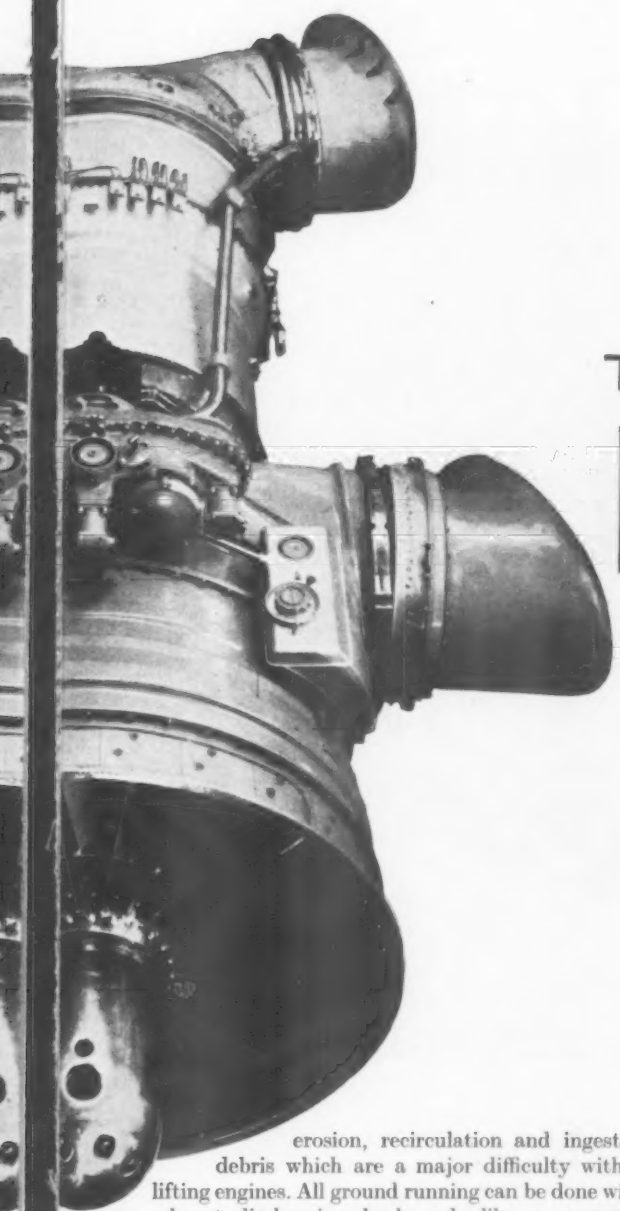
VTOL, STOL and normal take-off capability. The most revolutionary feature of this unique engine is that the thrust can be evenly applied around the centre of gravity through four movable nozzles which are directed downwards for lift, backwards for thrust, forwards for braking in flight, or in any intermediate direction. This feature makes possible, for the first time, the design of single or multi-engined aircraft in which the total installed thrust is available for vertical or short take-off with a normal payload or for conventional take-off with a large overload.

High cold-flow ratio, high thrust, low fuel consumption. The BS 53 is a high-thrust engine and the basic design concept which makes its versatile performance possible is a high cold-flow ratio.

A fan, located at the front of the engine, draws in a large mass of air, over half of which by-passes the main engine and is ejected in the form of a cool, relatively slow-moving stream through the two forward nozzles. The remainder passes through the gas generator and supplies thrust to the two rear nozzles. This arrangement greatly improves the Froude efficiency and gives the BS 53 a higher thrust/weight ratio, a lower specific fuel consumption and a lower noise level than any turbojet of comparable power in existence today.

Conventional installation, operational simplicity. The BS 53 is installed normally, with forward-facing intakes and the majority of its components are based on well-known principles already proved in service. These factors make for operational simplicity, easier maintenance, greater reliability.

Reduced problems of ground erosion and recirculation. Because the velocity and temperature of its jet effluxes are low, the BS 53 minimises the problems of ground



THE REVOLUTIONARY BS 53 TURBOFAN

erosion, recirculation and ingestion of debris which are a major difficulty with fixed lifting engines. All ground running can be done with the exhaust discharging backwards like a conventional turbojet. Taxying also is perfectly normal, and at take-off a short forward roll before the nozzles are deflected downwards ensures that all debris is left behind. As a result, the BS 53 does not require prepared sites and is *independent of all fixed ground installations.*

Selected for the world's first VTOL fighter. The Bristol Siddeley BS 53 has received the support of the Mutual Weapons Development Programme for NATO, and has already been selected for the world's first fixed-wing, aircraft designed for operational service with V/STOL capability—the Hawker P 1127. Although this remarkable engine was primarily designed for this type of aircraft, it is equally suitable for any single or multi-engined, subsonic or supersonic aircraft which requires VTOL or STOL capability.

...ANOTHER ENGINEERING ADVANCE BY BRISTOL SIDDELEY

BRISTOL SIDDELEY ENGINES LIMITED

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The last British aircraft to be built without the help of Desoutter power tools?

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Air Transport . . . .

No VFR Approaches at Rome

ON Aug. 22 and 23, representatives of all airlines using Ciampino held a meeting in Rome with the Italian Air Ministry and the control staff of Rome A.C.C. The purpose of the meeting was to examine, in the light of the recent near-miss, whether any changes in procedure should be recommended.

Capt. J. W. G. James, B.E.A. Flight Operations Director, strongly supported by T.W.A. and others, proposed that all airline operators should instruct their pilots to refrain from cancelling IFR flight plans for the period up to Sept. 17. This, he explained, was an IATA recommendation to which 13* of the 22 airline operators using Ciampino had agreed. The proposed period of the restriction would cover the Olympic Games in Rome and could be reviewed before Sept. 17.

Col. Paschina, the director of Rome A.C.C., expressed his willingness to accept the proposal but pointed out that the banning of all VFR approaches would certainly result in some delays. Alitalia was the only airline which expressed disagreement with the proposal, pointing out that, as the major user of Ciampino, it would be the most affected by delays. Alitalia, however, agreed to abide by a majority decision.

Other detailed proposals for varying the procedures at Ciampino were discussed. The only proposal agreed was that Alitalia pilots under control of Rome A.C.C. should use the English language so that pilots of other airlines should understand the instructions given.

It was finally agreed that the Italian authorities should immediately issue a NOTAM to the effect that Rome A.C.C. would not accept the cancellation of IFR flight plans for the period up to Sept. 17 although requests by pilots to carry out VMC climbs and descents could be authorized in certain conditions and on certain routes.

Another meeting will take place in Rome on Sept. 14 to review the effectiveness of the new procedure.—T.D.C.

* Since receiving this report we have learned that 19 operators have agreed to the ruling for the Rome area.

The Il-18 Grounded

IN a move which has no known precedent, the Russian authorities grounded all Ilyushin Il-18s at the end of last week. This followed an accident to an Il-18 near Kiev on Aug. 17, on the service from Cairo to Moscow. Reports from Cairo said that the Aeroflot aircraft caught fire in the air. The 27 passengers—including a Yemeni Government delegation on its way to Peking—and crew of eight were reported to have been killed. The cause of the crash can only be guessed at in the absence of information from Moscow, but the grounding order suggests the discovery of a design fault.

The service in question, SU035, leaves Cairo at 10.00 hrs. on Tuesdays, Wednesdays and Saturdays, the Tuesday service being via Tirana and the others direct to Moscow. Aug. 17 was a Wednesday. All these services have been operated by Il-18s for the past several months.

It appears to have been Russian policy in the past to announce only those flying accidents in which foreign nationals are killed—such as the crash of a Tu-104 near Sverdlovsk some two years ago.

Short's Baby Freighter

IN these days of highly sophisticated transport aeroplanes, a project like the Short SC.7 Skyvan almost inevitably appears to be over-simplified if not actually crude. It would be unfortunate if this impression were allowed to gain prominence, for there are no inherent aerodynamic or engineering reasons why a simply conceived and robustly constructed aeroplane should not be successful in its own rather specialized sphere.

Reflecting on the design philosophy of the Skyvan—which was described in our previous issue—one is led to conclude that here is an entirely practical and logical attempt to meet a set of requirements which, in their own way, are as stringent as those of the most exacting airline. Short's interest in the all-freight aircraft began in 1954 and while one line of research led eventually to the Britannic, another was suggested by the company's own experience with a conventional light twin used for communications and as an "aerial shooting brake." Pursuit of this line of thinking led Shorts to the HDM106 project of F. G. Miles, which by agreement was further developed into the Skyvan at Belfast. Little of the HDM106 remains, in fact, other than the basic concept and configuration.

Development so far has been as a private venture, the Skyvan being the first project of Short's Light Aircraft Division. The first of two prototypes is expected to fly in the middle of next year (at Belfast) and production of an initial batch of 25 will then be put in hand so that first deliveries can be offered a year later, by which time the C. of A. will have been obtained. A typical selling price, fully equipped, will be £55,000, based on recovering development costs over the first 100 aircraft.

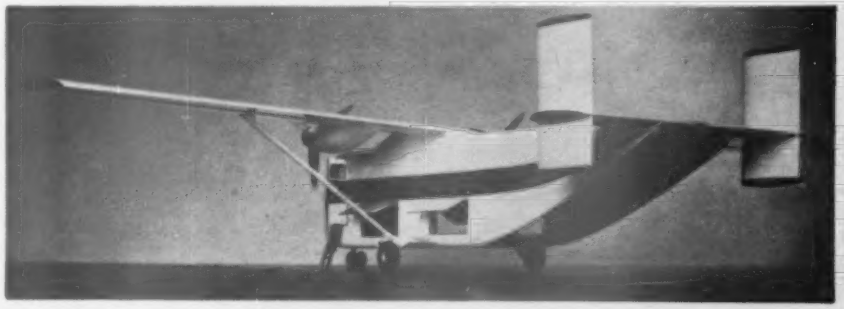
The Skyvan is a smaller aeroplane, probably, than many people realize. The table opposite, in which it is compared with some of the aircraft with which it can be expected to compete, helps to show where it fits in the light transport spectrum.

This table shows that the Skyvan is the lightest of the twin-engined aircraft, yet has a good payload and the roomiest cabin. The aeroplane has, in fact, been designed around the cargo hold, the size of which was fixed to accommodate almost any conceivable load (including a car) of up to 3,000 lb. in weight. To permit "straight-in" loading through the rear doors, the fuselage is untapered in plan view.

	Gross Weight	Payload	Cabin Dimensions
Skyvan ..	8,600 lb.	3,000 lb.	16 ft. x 6.5 ft. x 6.5 ft.
Twin Pioneer	14,600 lb.	4,000 lb.	19.5 ft. x 6 ft. x 5 ft.
Dove 5 ..	8,800 lb.	2,000 lb.	14 ft. x 5 ft. x 4 ft.
Otter	8,000 lb.	3,000 lb.	16.5 ft. x 5.5 ft. x 5 ft.
S.55	7,500 lb.	2,000 lb.	10 ft. x 5.5 ft. x 6 ft.

STOL performance is not claimed for the Skyvan, but its take-off and landing requirements are modest enough for most parts of the World. Shorts adopted the interesting procedure of balancing the take-off and landing distance—over 35-ft. and 30-ft. screens respectively—in the highest and hottest combination likely to be experienced: ISA+30° at 5,000 ft. In these conditions, the second segment climb is 188 ft./min. on one engine at max. take-off weight. The B.C.A.R. climb requirements can be met at weights up to nearly 10,000 lb., suggesting the development later of a "Mk. 2" Skyvan with a 4,000-lb. payload.

An interesting feature of the flight deck is the layout for single-crew operation. This dictated the grouping of radio and navaids on the central console, and location of engine controls in the roof, where they are conveniently near the engines. The standard of equipment is high, with duplicated VHF or HF and VOR, single or twin ADF and RMI. Short Brothers are proposing to make these standard fittings in order to keep the price down. To the S.B.A.C. formula, direct operating costs over 300 miles work out at 25d./ton-mile—but the company very sensibly believes that most likely customers for an aeroplane like the SC.7 are going to be more concerned with the capital outlay than with formula costs for operations.



Features of the Short Skyvan shown here are the "straight-in," full-width loading through the rear door, the fuselage side hatches to permit loading of cargo from the outside and the wing position on top of the fuselage.

Air Transport . . . .

IATA At Copenhagen

SOME 300 delegates and observers are expected to gather in Copenhagen next week-end for the 16th Annual General Meeting of IATA, which will take place from Sept. 12 to 16. This meeting will follow closely the established pattern for IATA A.G.M.s, with opening and closing sessions in public and a series of closed sessions at which delegates will receive reports of the various committees. No decisions of major importance are expected to be taken.

Mr. Ake Rusck, president of S.A.S., will take office as president of IATA, in succession to Mr. Seijiro Yanagita, president of Japan Air Lines. Their Majesties King Frederick and Queen Ingrid of Denmark and members of the governments of the three Scandinavian countries will be present at the opening session.

The 1961 A.G.M. is to be held in Sydney. Sir Hudson Fysh, chairman of Qantas, is expected to be elected president for 1961.

The Air-Freight Business

AS explained in last week's issue, B.E.A.'s overall freight ton-miles increased by 28.2% and the breakdown into international and domestic traffic is seen in the table, right. The international increase of about 25% compares with an average increase of about 20% for the major European carriers in 1959.

One of the difficulties about freight development on a fill-up basis—even with aircraft of the Vanguard's capacity—is that the available loads do not necessarily suit the available payload/volume and aircraft cannot always be topped up on emptier sectors without a great deal of hard selling. B.E.A.'s Channel Islands services—which do not pay their way because of the immense peak/trough disparities—are a case in point. The variation in passenger loads between summer and winter is in a ratio of 9 : 1, but there is just not the available cargo traffic to fill the aeroplanes during the slack season. Fresh flowers might be thought, for instance, to be a worth while return load in the early spring—but they are unattractively bulky in relation to their weight.

B.E.A. FREIGHT PROGRESS

	Summer 1959 (ton-miles)	Winter 1959-60 (ton-miles)	Year 1959-60 (ton-miles)	Variation on 1958-59 (%)
International	7,184,243	5,567,592	12,751,835	+ 24.8
Domestic	1,144,572	997,507	2,142,079	+ 52.5
Total	8,328,815	6,565,099	14,893,914	+ 28.2

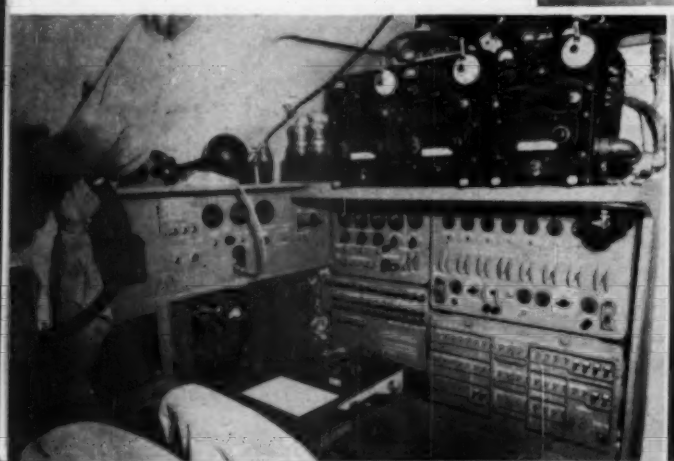
The biggest freight increases for B.E.A. in 1959-60 were on the routes to Milan, Malta, Nice and Copenhagen and on the short cross-Channel routes. All-freight aircraft (Viscount 802s are being used to an increasing extent) carried 36% of the international traffic, by comparison with 35% in 1958-59.

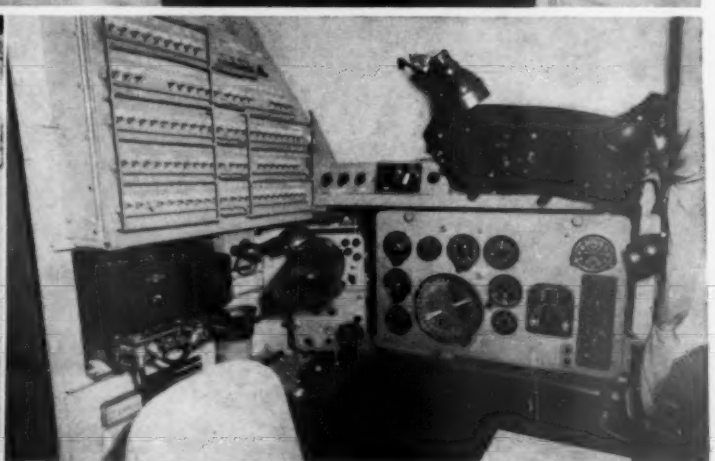
New L.A.P. Commandant

MR. G. J. WARCUP has been appointed to succeed Mr. G. J. H. Jeffs, C.V.O., O.B.E., as commandant of London Airport at the end of September. Mr. Warcup is at present divisional controller of the northern division, M.o.A. He served with the R.A.F. from 1941 to 1946, retiring with the rank of Wing Commander.

He became an operations officer with the M.C.A on leaving the R.A.F., and was appointed a deputy director in 1947. In 1949 he was appointed U.K. member of the Navigation Commission of ICAO and in 1954 became D.C.A. in Malaya. He returned to the M.T.C.A. as divisional operations officer in the southern division in 1957, and moved north to be divisional controller in April, 1959.

As reported in our issue for Aug. 19, Mr. Jeffs is to be retained by B.O.A.C. on a part-time basis to advise and assist the Corporation's management at L.A.P. He retires from the M.o.A. on Sept. 30.





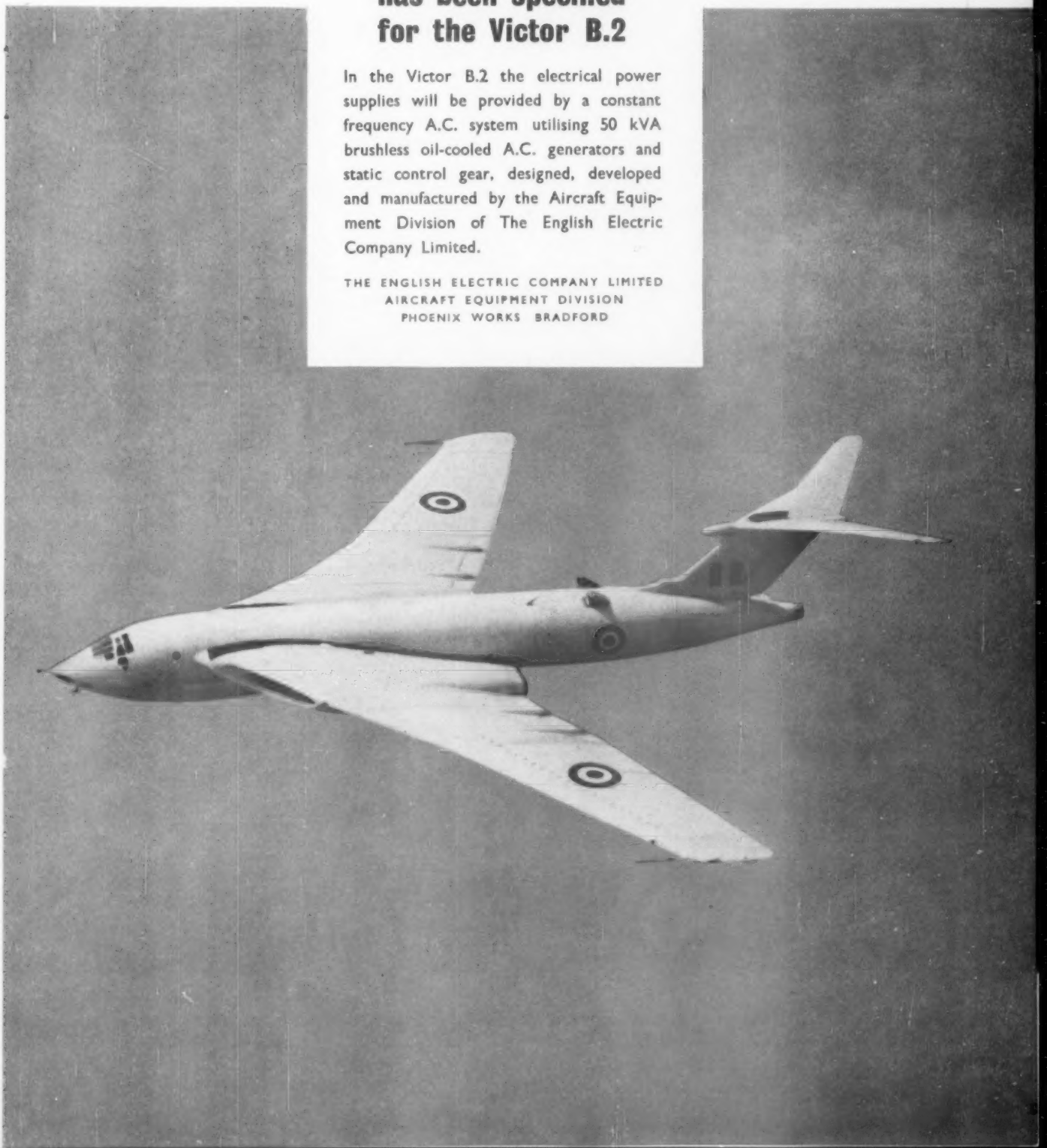
FLIGHT DECK FOR C.S.A.—Views of the Ilyushin Il-18's control cabin as this has been laid out for Ceskoslovenske Aerolinie. Below, left, is the radio operator's position, which is on the starboard side behind the first officer; right is the navigator's compartment. The pilots' controls and instruments show a few variations on the original layout in the Aeroflot Il-18 seen at the Paris Aero Show and illustrated in our issue of Sept. 4, 1959, p. 87. All the equipment appears to be of Russian origin with the exception of the Collins 17L VHF transmitter and 51R VHF receiver visible on the left of the picture of the navigator's compartment.

'ENGLISH ELECTRIC'

constant frequency AC generating system has been specified for the Victor B.2

In the Victor B.2 the electrical power supplies will be provided by a constant frequency A.C. system utilising 50 kVA brushless oil-cooled A.C. generators and static control gear, designed, developed and manufactured by the Aircraft Equipment Division of The English Electric Company Limited.

THE ENGLISH ELECTRIC COMPANY LIMITED
AIRCRAFT EQUIPMENT DIVISION
PHOENIX WORKS BRADFORD



Airview of 1960

THROUGHOUT THE WORLD, products of Hawker Siddeley Aviation are earning the respect and confidence of pilots and of civil and military aviation authorities alike. As weapons in aerial defence, Hawker Siddeley aircraft are fulfilling a vital role, while, in the sphere of civil aviation, the name of Hawker Siddeley is synonymous with reliable, supremely economical airfreight and passenger transport.

(1) D.H. Dove (2) D.H. Heron (3) Avro 748 (4) A.W. Argosy (5) D.H. 121 (6) D.H. Comet (A) D.H. Caribou (B) Gloster Javelin (C) A.W. 660 (D) Avro Vulcan (E) Avro Blue Steel Bomb (F) A.W. Seaslug* (G) Firestreak* (H) Hawker Hunter Two-Seater (J) Blackburn N.A. 39 (K) Folland Gnat Trainer (L) D.H. Sea Vixen.
*Not to scale.

HAWKER SIDDELEY AVIATION

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Hepolite have an established reputation for the precision machining of gas turbine blades to the highest standard of finish and accuracy. They are specified in the engines fitted in the majority of the turbine powered civil aircraft now in service in the Western World.

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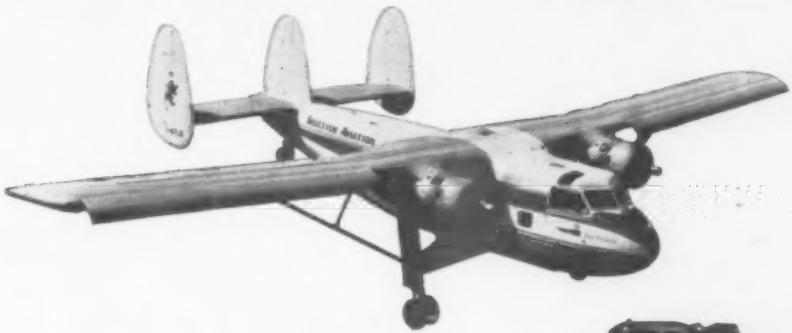

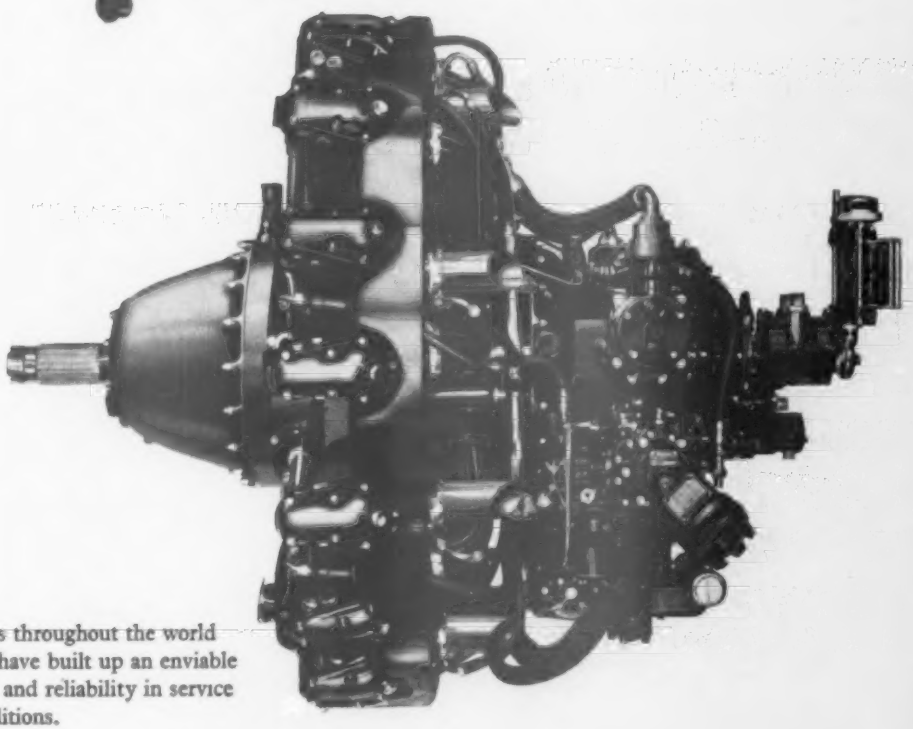

In twenty-four countries throughout the world Alvis Leonides engines have built up an enviable reputation for efficiency and reliability in service under many varied conditions.

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Melting metals in vacuo—a technique mastered by Jessop-Saville—makes possible steels of even greater strength. The best of air-melted steels are not free from non-metallic inclusions.

VACUMELT for components that must not fail

Vacuum melting permits closer control of chemical composition, and gas content, thus ensuring greater freedom from impurities. It gives "Vacumelt" steels improved ductility—on a 12% chromium steel sample, transverse ductility was *four times greater* than that of a similar air-melted steel—and higher resistance to fatigue and creep. For highly stressed steel components that must not fail, "Vacumelt" is essential.

Hylite

Jessop-Saville have also developed the "Hylite" Titanium alloys to meet the design requirements of high-speed aircraft and missiles. They are available in 9 different grades with U.T.S. values ranging from 27 tons to 80 tons/sq. in.

Full particulars and technical data on "Vacumelt" steels and "Hylite" Titanium from Jessop-Saville

JESSOP SAVILLE

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A Member of the B.S.A. Group

P3415

SPERRY

Navigation, Control
and Instrumentation for
high-performance Aircraft

Yet they call it driving rain!

Such a description might amuse the driver of this Shell tank lorry as he peers through the almost blinding sheet of rain. Nice weather for ducks, perhaps, but not for driving heavily-laden lorries.

But he presses on. His cargo is aviation fuel and his destination is Niamey, a major airport across the Niger in West Africa. Niamey needs supplies in bulk all the year round; yet each delivery means an 800-mile journey from the nearest supply port at Lagos — 800 miles through sub-tropical forest, dense bush and barren plain in all extremes of weather from scorching drought to lashing rain.

The fuel is first shipped by lighter from Lagos 120 miles across the lagoon to Porto Novo. It then travels 300 miles north by rail wagon through jungle swamp to Parakou. From there tank lorries slog out the final gruelling 375 miles to Niamey. Many problems have had to be tackled to get supplies through on schedule. For example, the ancient ferry over the Niger; the treacherous track which, when the rains come, can quickly change from hard corrugated ruts to a sea of mud. At one time the lorries got bogged down frequently and supplies had to be sent by rail to Kano and then by road to Niamey — some 1,200 miles to supply a point only 620 miles from the coast!

But one by one the problems have been overcome and the route improved. Local interests have built 120 miles of bitumen roads (bitumen from Shell). A bridge has now replaced the antiquated ferry over the Niger. Niamey never has, and never will, run short. Wherever an airfield is situated, Shell will supply it — whatever the difficulties may be.

SHELL

you can be sure of Shell

The Fighting Services

Naval Promotion

ACTING ADMIRAL SIR ALEXANDER BINGLEY, K.C.B., O.B.E., Commander-in-Chief, Mediterranean, has been promoted to the rank of Admiral.

A qualified Observer, he was promoted to Rear-Admiral in 1954 and then served at the Admiralty for three years as Fifth Sea Lord. He became a Vice-Admiral in 1957 and in January, 1958, was appointed Flag Officer Aircraft Carriers.

Technical Training Command

AIR COMMODORE A. T. MONKS, C.B., has become Senior Air Staff Officer, Technical Training Command, with the acting rank of Air Vice-Marshal.

Since 1945, Air Cdre. Monks has been Deputy Director of Telecommunications and Deputy Director of Signals (Ground) at the Air Ministry and has commanded Nos. 1 and 4 Radio Schools. Prior to taking up his new appointment at the end of last month he was Controller of Telecommunications at Headquarters, Signals Command.

Senior R.C.A.F. Postings

AIR VICE-MARSHAL J. G. KERR, C.B.E., A.F.C., has been posted to the Headquarters of 4th A.T.A.F. in Germany. He is being succeeded as Air Member for Personnel at Canadian Air Force Headquarters by Air Vice-Marshal W. A. Orr, C.B.E., who relinquishes his appointment as Commandant of the R.C.A.F. Staff College in Toronto.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Gp. Capt. G. K. Buckingham, O.B.E., D.F.C., Wg. Cdr. J. A. Hope, D.F.C., and Wg. Cdr. R. W. Hurst to the Department of the Air Member for Personnel; Wg. Cdr. G. Smythe, M.B.E., D.F.M., to the Department of the Air Member for Supply and Organization; Wg. Cdr. G. A. Sentance, M.B.E., to the Department of the Permanent Under-Secretary.

Bomber Command: Gp. Capt. F. M. Osborn, O.B.E., D.F.C., A.F.C., to Headquarters, No. 1 Group, as Senior Officer, Administration.

Fighter Command: Sqn. Ldr. P. C. R. Carrington, R.A.F. Regiment, to Headquarters as Senior Ground Defence Staff Officer, with acting rank of Wg. Cdr.

Coastal Command: Wg. Cdr. E. A. Cox to Headquarters, No. 19 Group, as Senior Technical Staff Officer.

Transport Command: Gp. Capt. J. J. McKay, D.S.O., D.F.C., to R.A.F. Dishforth to command; Wg. Cdr. A. A. J. Sanders, D.F.C., A.F.C., to No. 53 Squadron, R.A.F. Abingdon, to command.

Flying Training Command: Gp. Capt. R. W. Cox, D.S.O., D.F.C., A.F.C., to Headquarters as Gp. Capt. Organization; Sqn. Ldr. A. Cockman to the R.A.F. College, Cranwell, as Chief Instructor and to command the Equipment and Secretarial Wing, with acting rank of Wg. Cdr.

Technical Training Command: Wg. Cdr. J. H. Smith-Carington, A.F.C., to the Administrative Apprentice School, R.A.F. Bircham Newton for directing staff duties; Wg. Cdr. W. J. Winter, D.F.C., to Headquarters for organization duties.

Maintenance Command: Wg. Cdr. J. E. M. Mould to Headquarters, No. 41 Group, as Gp. Capt. Operations, with acting rank of Gp. Capt.; Wg. Cdr. W. D. Woods, to R.A.F. Wellsbourne Mountford to command the Technical Wing; Wg. Cdr. W. D. Symes to Headquarters No. 41 Group for equipment progress duties.

Signals Command: Wg. Cdr. K. E. W. Brace to Headquarters as Senior Equipment Staff Officer.

Other Appointments: Gp. Capt. J. O. W. Oliver, C.B., D.S.O., D.F.C., to the United Kingdom Delegation to the NATO Military Agency for Standardization; Gp. Capt. G. C. O. Key, O.B.E., D.F.C., M.A., to the Ministry of Defence; Wg. Cdr. J. R. Burges to the Ministry of Aviation, with acting rank of Gp. Capt.

A.T.C. Convention

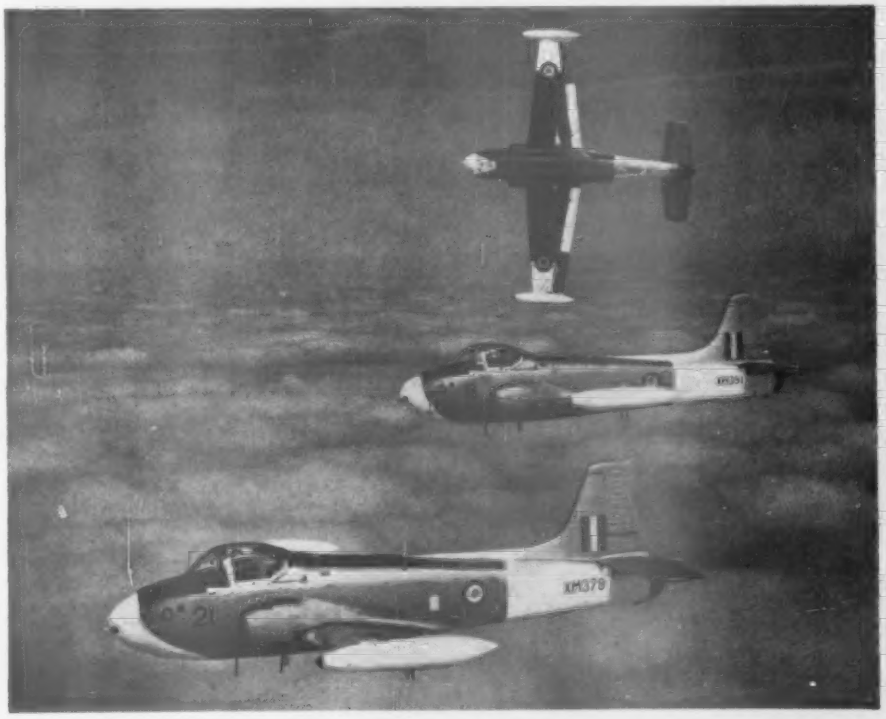
OFFICERS commanding Air Training Corps Wings in the United Kingdom are to attend a six-day convention beginning on Sept. 4 at Headquarters Air Cadets, R.A.F. White Waltham. The programme will consist of lectures and demonstrations and will include a visit to a Thor missile station and to the S.B.A.C. Display at Farnborough.

Among the speakers will be Sir John Wolfenden, Vice-Chancellor of Reading University, who, in 1941 when Headmaster of Uppingham, was made Director of Pre-entry Training at Air Ministry, a post specially created in connection with the Air Training Corps. He will speak on "Growing up in a Changing World."

More Service News

No. 92 Squadron Reunion.—Past and present members of No. 92 Squadron are invited to attend a reunion at Biggin Hill on Friday, Sept. 9, the 20th anniversary of the Squadron's arrival there during the Battle of Britain. Those interested are asked to contact the Squadron Adjutant, R.A.F. Middleton St. George, Darlington, Co. Durham.

Battle of Britain.—The Air Council reception to mark the 20th anniversary of the Battle of Britain is to be held in Lancaster House, St. James's, on Sept. 14. The Prime Minister has accepted an invitation to be present and the guests will be received by Mr. George Ward, the Secretary of State for Air.



ALL FLOWN AT SYERSTON. — Powered by a 1,760-lb.s.t. Bristol Siddeley Viper ASV-8 the Hunting Jet Provost T.3 is the first R.A.F. trainer to be equipped with UHF instead of VHF radio. Its two seats, side by side, are Martin-Baker Mk. 4 lightweight units. R.A.F. basic flying training with the Jet Provost comprises 79 hr. dual and 41 hr. solo.

Photograph copyright "The Aeroplane and Astronautics"

Second Report from Stockholm

Growing Use of Sounding Rockets

In this and the following article KENNETH GATLAND *continues his report of the 11th I.A.F. Congress.*

LOW cost, ease of handling, and hence relatively small size, characterized the sounding rockets discussed at a special symposium organized in conjunction with the 11th I.A.F. Congress in Stockholm on Aug. 16 and 17. Object of the meeting, which had been suggested by Prof. S. F. Singer of Maryland University, was to encourage more groups in other countries to engage in upper atmosphere research.

Work of the U.S. Navy in developing sounding rockets was described by LT. CDR. W. S. HOUSTON of the Office of Naval Research in Washington. After the Viking, a large liquid propellent rocket over 40 ft. long and 45 in. in diameter, with an all-up weight of nearly 16,500 lb., he said the general trend had been towards smaller, more efficient, and less costly rockets. Such vehicles were used both for the study of the Earth's atmosphere and to place instruments above the atmosphere to investigate the Sun and other planets. Aerobee and Aerobee-Hi represented the continuation of liquid propellent rocket development. Deacon, Asp and Arcas were the results of efforts to produce small solid-propellent sounding vehicles.

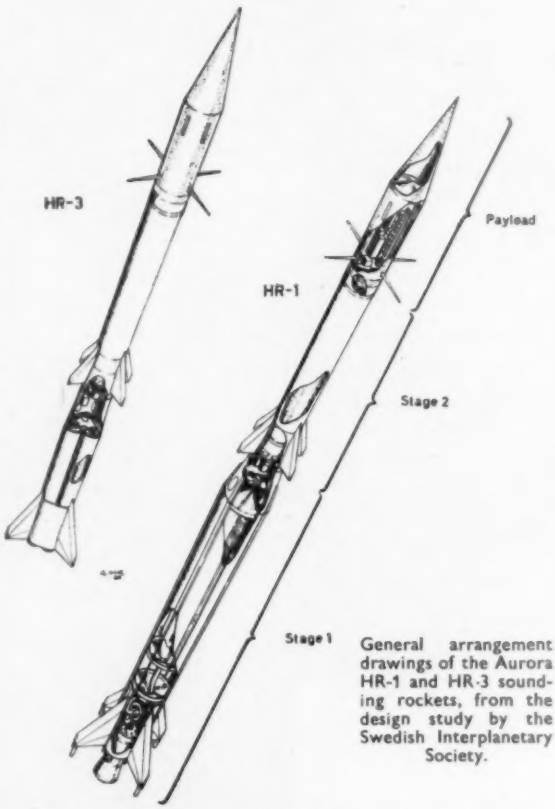
Use had been made of rocket motors derived from weapon systems, resulting in the Hasp or Loki-Dart and the Miral, or 2.75-in. air-launched sounding rockets. Combining sounding rockets with larger weapon-type boosters had led to the Nike-Deacon, Nike-Cajan and Nike-Asp. The last-named, Lt. Cdr. Houston said, was capable of lifting scientific payloads of one-tenth the weight of those carried by Viking to the same altitudes at one-fiftieth of the cost.

A large part of the instrumentation needed in order to utilize smaller, cheaper rockets, has also been sponsored by the U.S. Navy. As early as 1951, a complete meteorological sounding rocket system was produced to measure pressure, temperature and relative humidity. More recently, instruments used in balloons have been modified for rocket use. More accurate devices are under development.

Rocket Exhibition

Some of the latest small sounding rockets developed by the U.S. Navy were on show in one of the Congress exhibition rooms. Arcas, for example, can carry an 11.9 lb. payload to a maximum altitude of 34 miles, taking 128 seconds to reach the zenith. Its total launching weight, with payload, is 77 lb.

Part of the exhibition of small sounding rockets at the 11th I.A.F. Congress in Stockholm. Left to right: Asp, Arcas, Deacon, Hasp, and 2.75-in. FFAR.



General arrangement drawings of the Aurora HR-1 and HR-3 sounding rockets, from the design study by the Swedish Interplanetary Society.

Arcas is fired from a closed breach, portable launcher which permits a high order of accuracy. It relies on the initial exhaust gas pressure built up by the rocket to achieve a higher launching velocity than would otherwise be possible. The rocket can be aimed within a 20° vertical cone by means of azimuth and elevation adjustments. Total weight of the launcher, which has only five major parts, is 395 lb.; assembly can be completed by two men in two hours. The rocket is produced by the Atlantic Research Corporation, of Alexandria, Virginia.

The head section incorporates a low-cost rocket parachute, and telemetry and radio tracking equipment operating at standard meteorological frequencies. Special purpose sensors, pick-up transducers and research instrumentation may be developed or modified for research investigation. Meteorological sensors to determine upper atmosphere temperatures are available as standard components.

Upper altitude winds are measured by radio or radar tracking of the descending parachute and payload. Telemetry equipment is comparable with standard meteorological ground equipment.

Another interesting small sounding rocket is the Hasp, manufactured by Cooper Development, a division of the Marquart Corporation. Variants of this vehicle can lift a payload of 1 lb. to an altitude of 19 miles, or 3 lb. to an altitude of 38 miles.

Purpose of this vehicle is to obtain weather reports on a routine basis and is in regular use at the Pacific Missile Range. Launched from ships of the U.S. Navy, the rocket requires no

(Continued on page 277)

DART Herald

Pressurised civil or military jet-prop transport; 47 passengers or over 6½ tons of freight or combination of both at 275 m.p.h. for 850 miles; operates from 1000-yard grass airstrips; built for long life and easy maintenance; 1d a passenger-mile economy.

. . . flew a Herald on flood relief

While the Dart Herald was in Brazil recently—during one of its tough see-it-in-action proving flights which have taken aircraft of this type over 175,000 miles around the world to 53 widely differing countries—word came of devastating floods 800 miles away to the north-west. Its crew's prompt offer to help with flood-relief transport was immediately accepted.

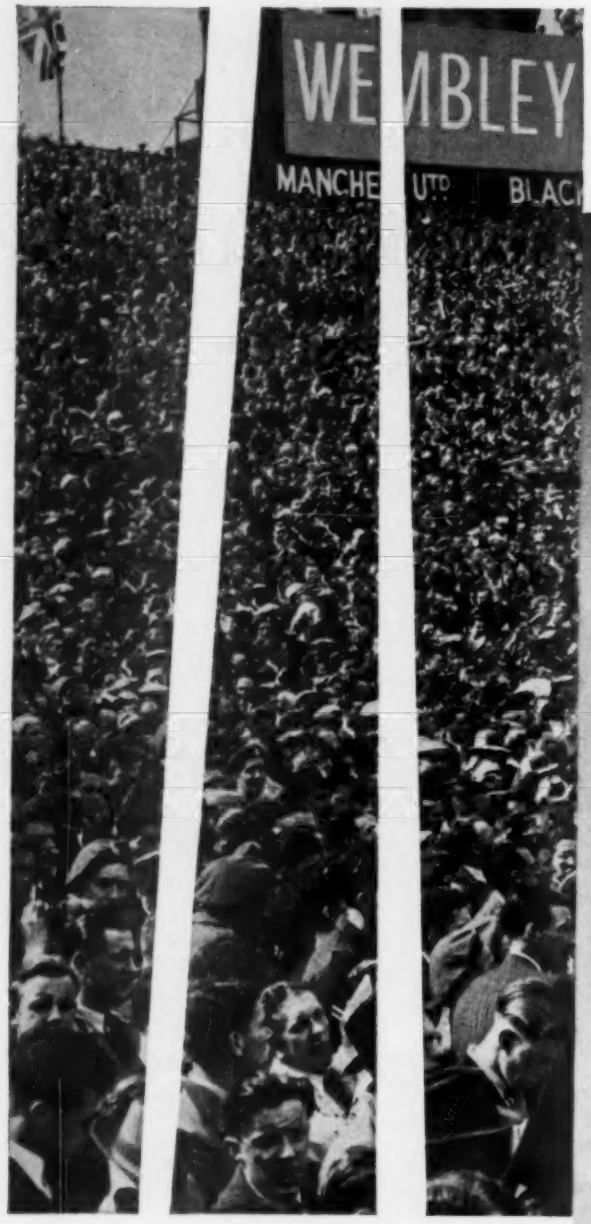
On one flight alone this Herald carried nearly 7 tons of clothing and other urgent supplies, spares and fuel from Recife to Fortaleza in the stricken area. Such a mission of mercy is indicative of its adaptability to local conditions and of its capabilities as airliner or freighter and as civil or military transport.

Heralds are built by Handley Page to fly; to fly strongly and safely with power to spare. They are making light work of some of the most difficult flying conditions and airstrips to be found anywhere.

Their fail-safe design, craftsmanship and Rolls-Royce Dart engines are guarantees of economy, versatility and safety.

Handley Page's pledge of after-sales-service continuity is the guarantee that Heralds will keep flying efficiently and inexpensively on the world's air routes.

HANDLEY PAGE RADLETT LONDON READING



WINGS DAY SEPT. 17th
GIVE FOR THOSE WHO GAVE

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IRVIN

(*Continued from page 276*)

special launching or tracking equipment; it merely employs the ship's 13 cm. (5 in.) guns and the gun direction radar. An empty shell casing is used to adapt the rocket to the breech and incorporates the fusing device.

The payload is carried in a slender dart which separates from the boost component at 2,500 ft. When the dart has coasted under momentum to an altitude of about 20 miles, its nose-piece is released and the body section then opens out to expose the payload. The latter consists of a balloon which inflates automatically to support a telemetering transmitter, antenna, and instrument package.

Radar chaff is used to obtain wind measurements. In Model 1, chaff is tracked from 19 miles down to 9.4 miles or for 20 minutes or more. In Model 2, chaff is tracked from 38 miles down to 19 miles.

At the same time, the instrument package transmits meteorological data to the tracking ship. In Model 1, the radiosonde is lowered by parachute and can be tracked from

Mr. Maurice Anthony of the Martin Company poses beside a 1/5th scale model of the proposed Swedish Aurora HR-1 high-altitude rocket. Note the clustered solid boost rockets between the tail fins of the first stage.

19 miles down to 7.4 miles or for about 30 minutes. The radiosonde of Model 2, similarly lowered by parachute, can be tracked down to 11 miles. This transmits data on temperature and pressure while radar is tracking the parachute to obtain wind direction and speed.

A mechanical time-fuse controls the altitude at which ejection of the payload occurs; this can vary between 12 and 120 sec.

Air-launching

A third rocket of interest is the 2.75-in. FFAR which is launched from an aircraft in level flight at a height of 3.7 miles. In this case, a multiple-tube launcher is provided in the aircraft inclined at an angle of about 45° above the horizontal and pointing aft. When fired, "wind cocking" causes the rocket to achieve a nearly vertical trajectory. It can reach an altitude of about 19 miles.

Another example of the small sounding rocket family was described by J. Grey of Princeton University and R. G. Van de Vrede of the Atlantic Research Corporation. This is the single-stage, solid-propellent vehicle known as Iris which is capable of lofting a 100-lb. payload to a height of some 200 miles. Largest of a number of long-burning-time sounding rockets developed by the Atlantic Research Corporation, it is similar in design to the operational Arcon (40-lb. payload to 65 miles) and the Arcas. Significant features of the Iris include its high performance capability, operational simplicity, moderate acceleration, relatively small size and weight, and advantageously low cost.

First firing of the new sounding rocket was performed by NASA at Wallops Island, Virginia, in July this year. Carrying a 150-lb. payload it was launched at 7° to the vertical. The calculated trajectory for these conditions predicted that the peak altitude would be 145 miles and impact point 203 miles. Preliminary test results gave the actual peak as 140 miles and impact point, 210 miles.

Swedish Rocket Project

Turning to work by other countries, the project study by the Swedish Interplanetary Society, under the name Aurora, is well worthy of mention. This very thorough investigation of the possibility of developing sounding rockets on the basis of existing Swedish designed and built rocket motors and other components was described by A. Hjertstrand, O. Ljungström, and L. H. Ågren.

Three different rockets are envisaged, HR-1, HR-2 and HR-3. The first two would be powered by the H_2O_2/kerosene rocket motor VR 3 developed by Svenska Flygmotor Aktiebolaget. Sea-level thrust is 4,900 lb., increasing to 5,700 lb. at 12 miles.

The HR-1 version has a second stage solid-propellent motor which could send a payload of 11 lb. to a height of over 248 miles. HR-2 is a one-stage variant of HR-1, intended for taking larger payloads to lower altitudes. Both would be fitted with four solid-propellent boosters intended to give the vehicles an initial acceleration of about 7*g* and permit use of a short launcher.

The final rocket considered, HR-3, is considerably smaller and would be propelled by the same solid-propellent motor used as the HR-1 top stage. It is provided with three short-duration boosters and would carry payloads of 11 to 33 lb. to altitudes of 50 and 40 miles respectively.

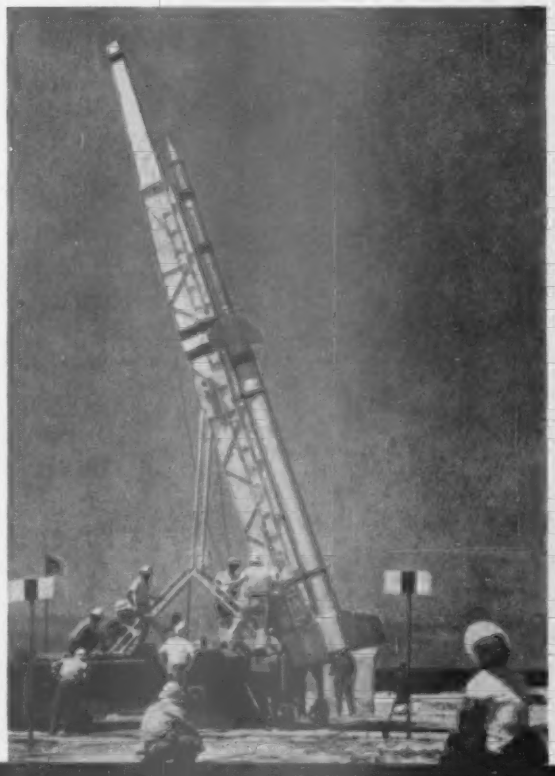
Japan's Sounding Vehicles

Since the beginning of the International Geophysical Year, Tokyo University has been extremely active in the development of rockets for sounding the upper atmosphere. Excellent work has been done on a modest budget. Prof. H. Itokawa gave some recent results at the Small Rockets Symposium in his paper, "Developments of Project Kappa in 1959-60."

Work during this period, Prof. Itokawa said, could be divided into three fields. First were refinements in the design of Kappa-6, the staged solid rocket which had been developed originally for the I.G.Y. The altitude performance at a launching angle of 80° had been increased from 37 to 50 miles, with the same payload.

The second task was to design and build two- and three-stage rockets of higher performance. Objectives here were an altitude of 124 miles with a 22 lb. payload for the first vehicle, and 248 miles with an 18 lb. payload for the second. A four-stage rocket was also being studied in 1960, with an altitude reach of 370 to 620 miles.

First firing of Kappa-8 with a dummy second stage took



The size of Japan's latest high-altitude rocket, Kappa-8, is clearly apparent in this picture taken at the Akita Rocket Range of Tokyo University. In two firings on July 11 and 17 this year, altitudes of 93 and 113 miles were attained.

place at the Atika rocket range of Tokyo University in March this year. Initial launching of Kappa-9 is expected in the latter half of 1960; it is hoped to reach an altitude exceeding 248 miles. The four-stage rocket, Kappa-10, is scheduled for launching next year, and with this it is hoped to extend present upper atmosphere research, including temperature, wind and solar spectrograph studies, to embrace the requirements of ionospheric research and the measurement of high-energy cosmic particles.

Prof. Itokawa showed examples of telemetering equipment carried by the early Kappa rockets. There were photographs also of five- and six-shot grenade containers, and a solar spectrograph which had been recovered from the Sea of Japan after landing by parachute.

The third aspect of Japanese research and development concerns the problem of reducing still further the cost of upper air sounding. A single-stage rocket of high specific impulse has been developed under the designation, Pie. This has a glass-fibre reinforced-plastic casing. Work is also proceeding with steel and plastic-cased spherical rocket motors for use as upper stages.

A Low-cost Japanese Satellite?

A novel suggestion put forward by the speaker was that a four-stage solid rocket, developed from the Kappa series, might be capable of putting a small payload into orbit without any form of guidance. If sufficient support were forthcoming, it might be possible to reach this stage in the Japanese programme by 1962.

The technique involved is characteristically Japanese in its ingenuity. The launching rocket would consist of two solid-propellent stages of conventional design, with two upper stages comprising spherical rocket motors of high efficiency. The plan would be to launch this four-stage vehicle on a simple, unguided, ballistic path and to fire the two spherical motors in quick succession at the zenith.

To overcome the heading problem of the second stage, Itokawa proposes to spin-stabilize the tandem spherical rockets in a gimbal frame before launching, by means of an electric motor. Thus, they would be kept in a horizontal attitude in respect to the ground up to the maximum altitude, when they would be fired to achieve an orbit.

Electrical Rocket Propulsion

AN account of a 30-kW. arc-jet engine of the type which may be used to keep a 24-hr. communications satellite on station above the Equator, or change the orbiting altitude of spacecraft, was given at the I.A.F. Congress in Stockholm by R. R. John, J. F. Connors, and A. Mironer, of the Avco Corporation. Such engines at present have a thrust level of 0.5 to 1.0 lb., with a specific impulse of 750 to 1,500 sec.; one has run continuously at Avco's Research and Advanced Development Division for about 50 hours.

Principle of the engine is simple. A complete propulsion system would consist of the arc-jet engine, an electrical power supply, and a tank of working fluid (e.g., hydrogen or helium). The working fluid is injected into the arc chamber, heated as it passes through the discharge, and is expanded through a conventional nozzle. The nozzle serves to convert the ohmic heating in the electric arc discharge into kinetic energy. No effort is made to produce thrust by the interaction of electromagnetic fields and the working fluid. The arc-jet is thus basically similar to the chemical rocket, differing only in that energy is introduced into the arc chamber by a continuous electrical discharge rather than by chemical reaction.

As the thrust produced is so small, the engine could only be used in a vehicle which is already established in space. The 24-hr. communications satellite is regarded by Avco as a promising example of the use of thermal arc-jet engines since, in any case, heavy power supplies must be carried for operating the communications equipment.

In their studies, Avco have considered the hypothetical case of a 1,500-lb. payload of communications equipment which has to be transferred from a 300-mile circular orbit to a stationary orbit at 22,300 miles above the Equator. For such a mission, some 2,500 lb. of hydrogen would be required as propellent, with 1,000 lb. of tank structure, insulation, pumps and controls, and 2,500 lb. of electrical generating equipment. Proposed power supply is the 30-kW. Snap-8 nuclear-electrical system being developed by the Atomic Energy Commission.

To achieve the desired transfer, the arc-jet engine would have to operate for about 30 days, during which time the vehicle would slowly expand its orbit out to 22,300 miles. At this point the engine would be shut down and the power supplies switched over to work the communications equipment.

There are hopes that an arc-jet propulsion system of this capability will be available in two to three years. Even without the dual-purpose use of the power supplies, Avco have calculated that the arc-jet would still have a significant net weight advantage over a chemical rocket system for transferring a given payload into a higher orbit. Where journey time is unimportant, the higher specific impulse offered by the arc-jet system means that heavier payloads could be sent to the Moon from the staging orbit. The longer transit time would, in fact, be an advantage for obtaining comprehensive measurements of the Earth-Moon environment.

As a longer-term possibility, it would also seem that arc-jet spacecraft may be suited to the transportation of heavy supplies between Earth and Moon in support of manned operations. Preliminary estimates suggest that payloads of between 10 and 200 tons might be transferred in this way with journey times ranging between two and eight weeks. This, however, would imply the use of more efficient electrical conversion apparatus.

One of the features of all electrical propulsion systems is that they exchange high-thrust operation, as in the case of chemical rockets, for low-thrust operation over long periods of time. The operating life of an arc-jet engine is determined by electrode, nozzle and insulator life. Present bench tests at Avco are designed to explore the problems of achieving long operating life, with particular attention to electrode erosion and cooling of the nozzle in a space environment.

The most successful electrode and nozzle materials in current use are uncooled and cooled thoriated tungsten and copper. Eventually, it is hoped to have such power units running continuously for weeks on end.

Ion-Drive

Another important electrical propulsion system is the ion-rocket (I_s = 2,000-5,000 sec.), which operates by the acceleration of positively charged particles (ions) ejected rearward by an electrostatic field. In the United States, electrostatic systems have been operated with caesium as propellent at exhaust velocities of 40 to 60 km./sec.

In a lecture surveying "Progress in Electrical Propulsion

(*Continued on page 279*)

A 30-kW. arc-jet rocket engine in operation at Avco's Research and Advanced Development Division. Continuous operation has been achieved for some 50 hours.

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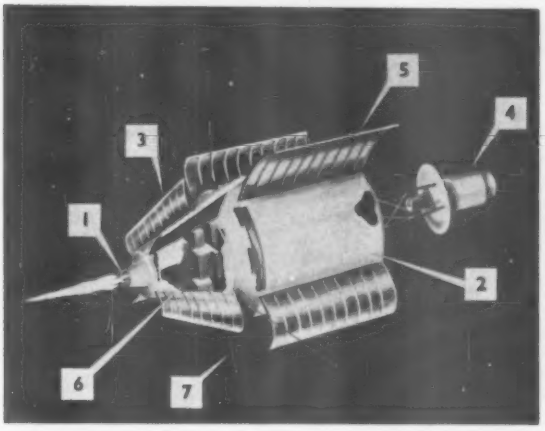
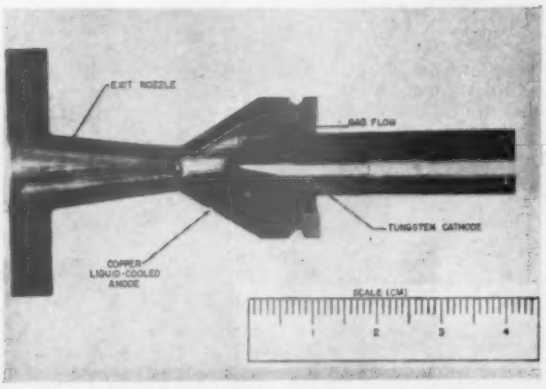
(*Continued from page 278*)

Systems for Space Vehicles," Dr. E. Stuhlinger, of the Marshall Space Flight Center, Huntsville, Alabama, dealt with the prospects of ion-drive in some detail. While ion sources and beam formation did not offer serious difficulties, he said, the efficient neutralization of the ion beam after leaving the thrust chamber was still not completely solved. He was confident, however, that electrostatic systems of this kind would eventually achieve power efficiencies of the order of 85%.

When efficient ion-drive systems are produced—and much depended on achieving a high-energy, lightweight, electrical generating system—it is possible to think in terms of vehicles which could convey heavy payloads between the planets. For future manned flights to Mars and Venus, said Dr. Stuhlinger, heavier payloads could be transferred than could be carried by chemical rockets of the same all-up weight. Moreover, because of the enormously greater distances to be traversed, journey times would not be very different between the two systems because of the long period during which the ion-rocket would be under low, but continuous, acceleration. Thus, the ion-rocket would be expected to provide larger and more tolerable living conditions for the crew.



An early design by the Avco Corporation for a space-probe utilizing an arc-jet rocket engine. Key: 1. arc-jet engine; 2. Liquid hydrogen storage tank; 3. Radiator for cooling fluid (arc-jet); 4. Nuclear power supply; 5. Condenser for mercury turbine electrical generator; 6. Payload; and 7. Antennae.



Principal components of the Avco Model 50 arc-jet rocket engine are revealed in this sectioned view.

There were, however, a large number of problems to be solved before missions of this kind were possible. It was hoped to have an elementary flight-test prototype of an ion-rocket working in orbit within two to three years. This would operate for a limited period only to test the working of the ion-beam under actual space conditions, and would be without the nuclear-electrical generator.

The speed with which such propulsion systems were developed depended on the progress made with power supplies. A combination of fission reactor, turbo-generator, and radiation cooler offered at present the highest specific power figure of all possible power supply systems. Thermionic converters promised a higher specific power but were still some way in the future, Dr. Stuhlinger concluded.

Space Medicine at Stockholm

By Dr. A. E. Slater

BRITISH representation at the Space Medicine Symposium, which formed a section of the International Astronautical Congress, was twice as strong, quantitatively, as that in the technical sessions, for two papers were contributed from the R.A.F. Institute of Aviation Medicine at Farnborough.

Flt. Lt. J. C. Guignard, in a paper on "Human Response to Vibration Frequency," carried on from where he left off two years ago at a similar symposium in London. He now finds a vibration frequency of 3.4 cycles per second to have the worst effect on the pilot's performance, and there is surprisingly little difference between large and small men in the frequencies which are most easily taken up by their bodies. The bodily response to imposed vibrations is 90 degrees out of phase in the case of seat-to-head accelerations.

Dr. R. R. Coerman and Prof. K. O. Lange, who have done similar research in the University of Kentucky, described their findings that relaxation of muscles decrease the bodily response to buffeting, but a pressure suit or other contraint increases it. Like Dr. Guignard, they found that about 3 c.p.s. is the worst tolerated, because it is the response rate of the thorax and abdomen and can cause severe pain.

Flt. Lt. J. Billingham, in the other paper from Farnborough, described some experiments on keeping the body cool during intense heating of the cabin wall. Forced air ventilation through a suit was the method used, and there were ten separate circulation systems covering various parts of the body. The aim was to maintain a comfortable temperature of 33° C. (91.4° F.), but it was found that the skin at the point of air entry became too cold at 20° C., while the hands and feet became so hot at 40° C. that they sweated profusely, though quite locally. This was with a cabin wall temperature of 125° C., maintained for four hours. A suit has now been designed to equalize these temperatures, and a further invention is a "wire suit" which acts like a resistance thermometer.

Both the Farnborough participants were careful to emphasize that their work was done solely in the interests of aviation, even though it had astronautical applications.

A finding by Dr. Billingham, that pre-cooling the body increases the time it can tolerate excessive heat, might be coupled up with a paper by Professor J. M. Radulovic, of Yugoslavia, in which he not only said that cooling a tissue reduces the damage it can suffer from radiation, but that the damage is much less if the body is deprived of oxygen while it is being cooled. One wonders how many volunteers for space travel will be left by the time the medical experts have finished their preliminary investigations!

Of all space-medical problems, radiation hazards received the most attention at the recent conference in Stockholm, and anyone wanting a comprehensive review of the subject should read the printed version of a most excellent paper by Glauco Partel, of Rome, on "Biological Shielding of Nuclear Rockets." It is too long to summarize here, but a particularly interesting point is that the Boron 10 isotope, only recently produced, has 20 times the shielding power of lead.

Dr. Wright Langham, from Los Alamos, talked most entertainingly of radiation problems, including the effects of a "maximum credible accident" to a nuclear rocket motor. If it blew up on take-off, the site would still be dangerously radio-active after three years, but if it did so in the high atmosphere it would take 10,000 such explosions to produce as much fall-out as one atomic bomb.

Latest estimates of the newly discovered radiation belts round the Earth were given by Dr. Langham, who said that the inner belt extends only 10 degrees either side of the magnetic equator, while the less dangerous outer belt extends to 50° magnetic latitude. But, like all the experts I know of who discuss this matter, he assumed that every space traveller would have to go slap through the middle of this belt, though

I pointed out two years ago, and again since, that this is quite unnecessary because once a day the magnetic equator makes an angle of 35 degrees with the ecliptic, the plane near which the Moon and planets perform their orbits. So the inner belt could be by-passed with something like 15 degrees to spare.

The outer belt, it was pointed out in two Russian papers by S. Vernov and by N. V. Pushkov and others, is very variable both in density and in the position of its densest part.

But the greatest hazard of all is from streams of particles shot out from the Sun, called solar flares. At irregular intervals of a few years, a flare is produced of such magnitude as to be "catastrophic," in Dr. Langham's words, to any space expedition crossing its path, for the normal radiation in interplanetary space would be increased a thousandfold. It would have to be taken as a calculated risk, he told his Swedish hearers, just as the Vikings of old risked disaster from storms at sea.

Astronauts Meet in Stockholm

Above, right to left, Dr. Ernst Stuhlinger, who worked on V-2 guidance and control at Peenemunde and now director of the Research Project Laboratory, Marshall Space Flight Center, Prof. Hermann Oberth, "father of German rocketry," and Mrs. Oberth.

Left, Sir Harrie Massey gives the inaugural address on "Science research using space vehicles" at Stockholm's China Theatre.

Above. Pioneers of American rocketry at the I.A.F. Congress. Right to left, Dr. F. J. Malina of Wac-Corporal fame, with Milton Rosen, well known for his work with the Viking high-altitude rocket.

Above, Dr. L. R. Shepherd, B.I.S. President and a vice-president of the I.A.F. (left), with Dr. S. W. Pickering, director of the Jet Propulsion Laboratory, CALTEC.

Left, British participants. Left to right, Mr. M. N. Golovine, Dr. L. R. Shepherd and Dr. W. F. Hilton of the B.I.S. Council.

Above, Soviet scientists V. Krassovsky (left) and A. Mikhailov, who analysed the Lunik III Moon pictures.

Below, left to right, L. J. Carter, B.I.S. Secretary, with Blue Streak men G. K. C. Pardoe and T. W. Air, de Havilland Propellers Ltd.

Above, D. Cashmore, A. V. Cleaver, Mrs. Hurden and D. Hurden enjoy themselves on a cruise in the Swedish Archipelago.

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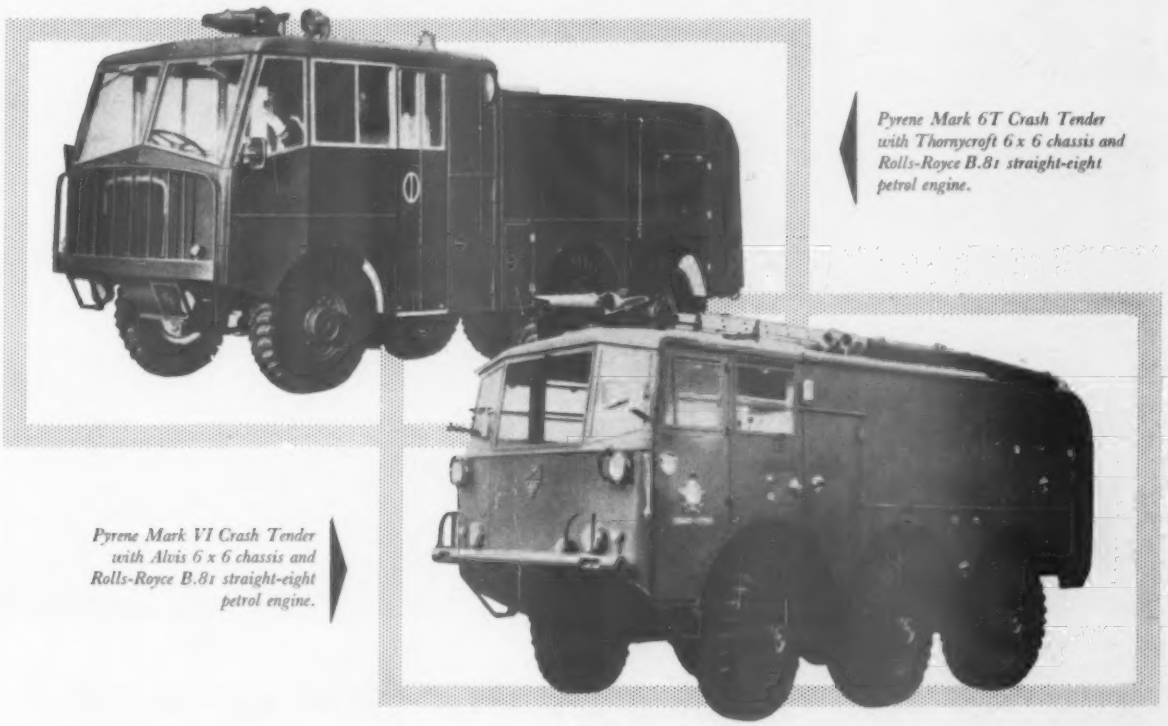

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When qualified, pay at age 20 is £949 a year: a married officer of 25 can receive up to £1,760 a year. After 12 years' service there is a tax-free gratuity of £4,000. Selected officers serving on a 12-year engagement may have the opportunity of transferring to a pensionable career.

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Right, Denis Hartas winner of the Tiger Race.

Left, competitors in the Tiger race negotiate the first turn.

Left, Mary Cazalet who won the Ladies Handicap Race.

Below, the Jackaroo race was won by Sheila Scott.

Thrills at Thruxton

Left, Ian Trethewy, winner of the race for Turbulents.

A MOST agreeable afternoon's sport was put on by the Wiltshire School of Flying at Thruxton on Aug. 21. Five short well-organized races attracted a fair entry and provided some excellent "dicing" thanks to good handicapping.

Mary Cazalet won the Ladies Handicap over a 58-mile triangular course by a matter of a foot from Margaret McKellar. Three short pylon races round the aerodrome gave spectators a good show of class-type racing.

Features were the very determined effort of veteran Norman Jones (winner of Air League Challenge Trophy 1927!) to catch Ian Trethewy and the breath-catching start of the Jackaroo Race with one competitor doing the first third of a bunt to add to the thrills. In the open handicap final, over the 58-mile course, the 2-seater Spitfire of V. Bellamy, the scratch starter, flashed across the line less than three seconds behind D. Phillip's Linnet.

Attendance at the meeting was fair. Anyone driving past on the A.303 was invited to come in and watch the sport free of charge. Quite a few did. It might well be that this sort of well-organized, not over-ambitious, Sunday programme is the effective way of bringing people back to the sport of flying. Certainly, everyone to whom I spoke regarded the occasion as being a truly happy one.—C.A.S.

Above, veteran inspection.

Above, competing aircraft in the Open Handicap race taxi-ing out. Right, turbulents in the line-up.

Photographs copyright "The Aeroplane and Astronautics"

Correspondence

Why Leave Manchester Out?

I NOTE from your issue of Aug. 19 that the usual annual arrangements for celebrating the Battle of Britain have been made, by the usual flying displays of the R.A.F. in the usual places throughout the usual areas.

Is it beyond the wit of the planners of this most important occasion to realize that the majority of the people of Britain would like to see this aerial memorial? Instead of which they are holding it in areas where only a fraction of the population will see it. Here in the north of England, particularly in the Manchester and the West Riding areas where over a third of the population of the country live, I doubt if any children have ever witnessed this annual event.

It is no use fobbing us off with those hoary old stories of flying over built-up areas. We have a fine airfield at Ringway. We have built some remarkable aircraft in the Lancashire area, you know. From recruiting figures we in Lancashire have excellent connections with the R.A.F. Perhaps some day it may occur to the planners to do something about it, meanwhile my children will have to watch TV to see what it is all about. But TV is a poor substitute for children when the Hunters roll.

Manchester. T. LEICESTER (ex-Flt. Lt.).

The Late "Gerry" Morel

I VERY much wish to associate myself with the remarks made in your issue of Aug. 19 by M. J. Buckmaster on the late "Gerry" Morel.

I knew him for some years, and it would be difficult to find a better friend or more gallant gentleman.

London, S.W.7. F. R. BANKS.

Private Venturing in A.T.C. Business

MR. MARTIENSSEN, in his letter (Aug. 12) states that, in the experience of SATCO, new developments tend to be more energetically and more successfully pursued when carried out by private enterprise, at least in the initial stages, rather than by Government support. In so doing, he seems to imply that the British electronic industry has fallen behind because it is in the habit of deferring the commencement of development work until assured of Government support.

This is far from being the case, as many of the large U.K. electronic companies will confirm. In fact, without private venture endeavour on the part of U.K. manufacturers, many of the tools used hitherto in air traffic control throughout the World would not exist. These tools range from high-power search radars to simple ground-based V.H.F. D/Fs and include highly sophisticated airborne navigational aids.

Perhaps it would only be fair to Mr. Martienssen to allow that his comment might have been directed at U.S. companies whose endeavours to provide partial answers to the air traffic control problem would have been pointless without F.A.A. support.

However this may be, it is important for all concerned with the air traffic control problem—the Government agencies, the airlines, and the electronics industries—to remember that A.T.C. is a World, and not a regional, problem. The solution to that problem will not be advanced by the over-enthusiastic plugging—as much by Government agencies as by industry—of competitive systems on either side of the Atlantic. Had this been apparent to the opposing factions at the regrettable I.C.A.O. meeting at Montreal in March, 1959, then the U.S. and Western Europe would now be in a better position to demonstrate to the rest of the World that there was a genuine interest in providing eventually a basic system capable of being employed universally. As it is, the World lies between the Scylla of VOR and the Charybdis of Decca.

Finally, having regard to the astronomical sums of money now being spent by Governments on space research (which includes basic work on communications satellites), especially in the U.S., would not Mr. Martienssen agree that adequate solutions to the World A.T.C. problem are more likely to be found by a better understanding of the relative rôles of Government agencies and industry in the field of scientific endeavour, than by isolated private enterprise within Government establishments and industrial research and development laboratories?

If so, I am sure he will be glad to know that the United Kingdom Government has seen the light which has been flashing with ever-increasing intensity during the last few years, and has, at least, accepted the idea of co-partnership. I strongly suspect that, despite the disclaimer in the fourth paragraph of Mr. Martienssen's letter, the Kingdom of the Netherlands has been less slow to realize its importance than he would have us believe.

Chelmsford, Essex. L. A. SWENY.

Groundabout

Farnborough's Aerolympic Games

They say it's only our sense of humour that keeps us going in aviation these days, and that the S.B.A.C. Display evokes the most strained humour of all. Latest of the "Dobson's Choice" generation of jests is the definition of next week's event as a Hawker Siddeley Air Show with guest artistes.

✱ Even the R.A.E. is getting, if not a new look, then an un-old one. The Beta Shed, 75-ft. high, built in 1905, has followed down Memory Lane the pioneering aerostats it once housed—Cody's kites and aircraft, our first airships, including "*Nulli Secundus*" I and II, the F.E.2 pushers, and many others. In it was built the Establishment's first wind tunnel, made of wood, canvas and wallpaper. Where once stood old Beta, there is for the time being a car park.

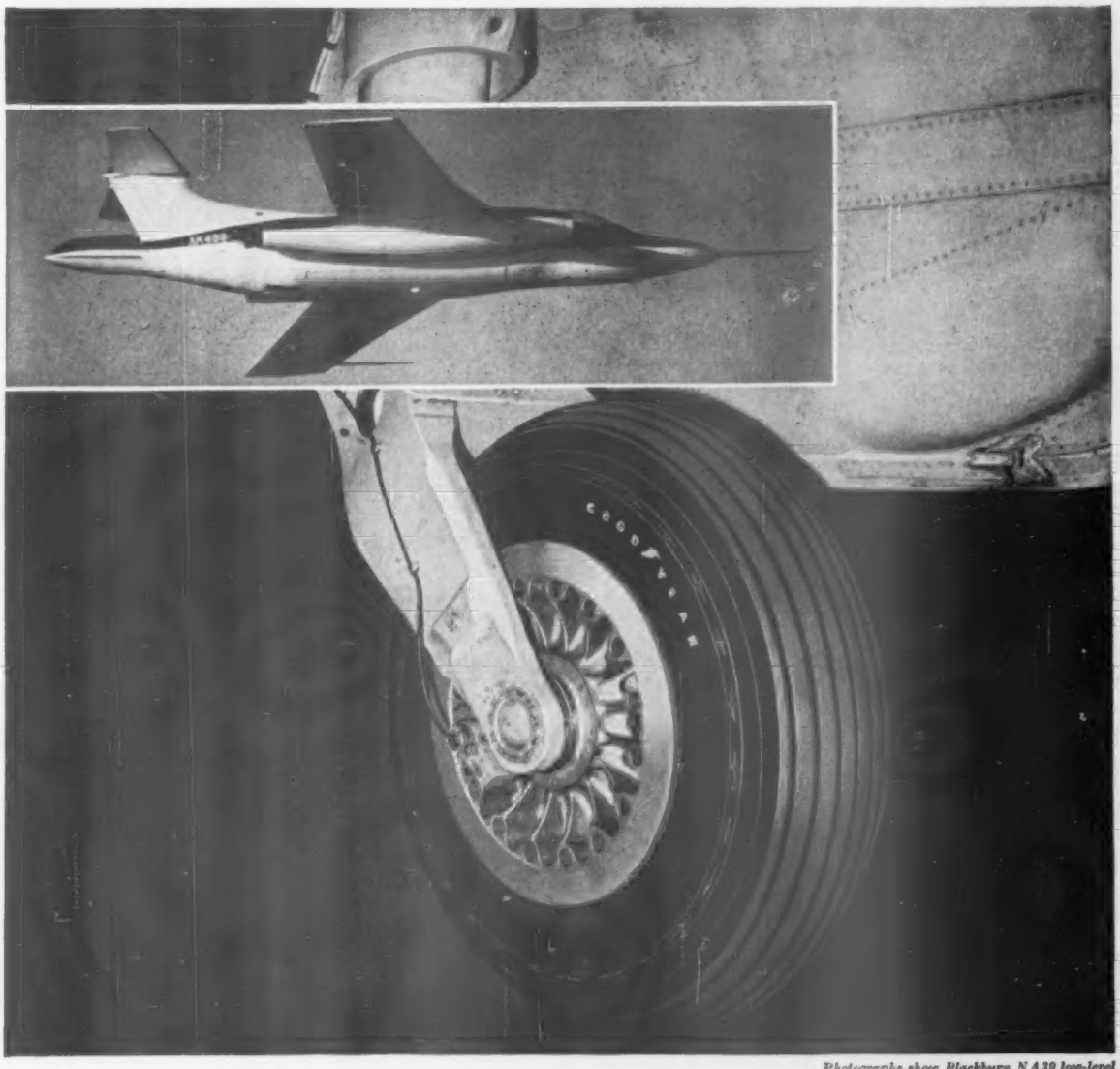
✱ Post-war piloting personalities change, too. Bill Pegg, Ben Gunn, Timber Wood (sound like a lot of buccaneers, don't they?), Neville Duke, and this year we shall miss Ranald Porteous, Roly Falk, Mike Lithgow, Walter Gibb and John Cunningham. And when Tom Brooke-Smith steps out of Short's SC.1 on Sunday, he retires, bow-tie and ebullience and all, from the test-piloting business.

✱ Gathering material for next week's Wrendering of the Display Pilots was a happy chore, as witness these sample extracts from replies to my questions: "What will you fly, how will you dress?"—"With the embargo on V-bomber aerobatics, all we have left is clambering swerves and noise . . .", "As the crop-duster Mk. 13 Javelin will not be ready in time, we've had to fall back on the Mk. 9 . . .", "Our P.R.O. Mk. XXX is confidently expected to beat last year's pint-to-pint record . . .", "I shall be flying the SC.1 all week in a mercurial manner—that is, up and down . . .", "As usual, I shall be flying the Boulton Paul Chalet . . .", "Very gnaturally, flying clothing will consist of gent's gnatty suiting, coming in two standard sizes—1, for the average R.A.F. man standing about 7-ft. 6-in. and 2, for troglodytes about 4 ft. 2 in." But there were also the touching "Regret . . . not this year" replies. Oh, well.

✱ The Hovercraft isn't likely to be present nor is the unique variation of it named in a letter from Germany as the "Hoovercraft" which obviously sucks instead of blowing.

✱ A technical magazine which should know better says that the Show "will perhaps be notable for three aircraft—the A.W. Argosy, Avro 748, H.P. Herald, and Fairey Rotodyne." As for the DC-3 replacement "Armstrong Whitworth look as if they may have the answer with their Avro 748." But how about the de Havilland Herald which is coming off Bristol's production line down at Weybridge?

by Sweny



Photographs show Blackburn NA39 low-level strike aircraft, and close-up of wheel assembly. By courtesy of Blackburn Aircraft Limited.

Blackburn NA39's will come in on Goodyear

Goodyear are proud to be associated with Blackburn Aircraft Ltd. in the supply of equipment for production in NA39 Aircraft.

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GOODYEAR AVIATION DIVISION

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At Manchester
Esso service demonstrates

CO-OPERATION WITH A CORPORATION

Airports and the methods of servicing have to keep pace with the speed of the aviation world. Planning for future development must be far-sighted. Decisions must be made quickly and put into effect with equal speed, otherwise current demands overtake new developments. There is no point whatsoever in designing for today.

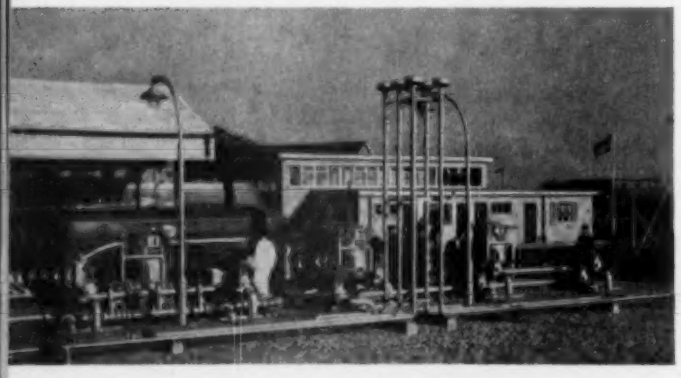
At Manchester municipal airport, Esso's refuelling crews play an important part in supplying the needs of present traffic, while engineers are working with the airport authorities on an impressive programme of future development. Manchester means business in the air — big business. Esso is proud to help.

Eighty years ago Manchester was an inland city, dependent upon world trade, but with communications to the sea that were inadequate for the greatly increased output occasioned by the Industrial Revolution. Manchester Ship Canal was the answer, transforming the city into a seaport. The stage was set for continued development which has led to the proud position the city holds today. Thus Manchester learned the value of adequate communications and with characteristic foresight the city was quick to appreciate the advantage of an international airport to put itself firmly on the air routes of the world.

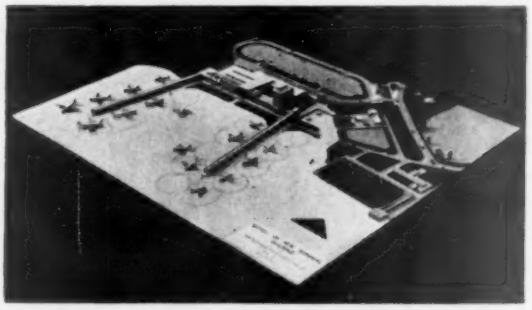
Already it is the second most important airport in the United Kingdom. Transatlantic, international and domestic air traffic all pass through Manchester and, as always, Esso's calculated hustle is suited to the local need. Compared with London Airport the percentage of domestic and short-range international traffic is higher. The quantity of fuel required per aircraft is correspondingly reduced, but quick turn-round is as vital to short-haul operations as it is to long.

As for the future, the City Corporation is preparing for the day when Manchester Airport will be even busier than it is at present. Long-range inter-continental and international traffic will increase while, at the other end of the scale, aerial commuting will be a matter of course. Helicopter services may well link Manchester with other cities throughout the United Kingdom.

Bulk storage of Esso aviation fuels in underground tanks. Fuels will be pumped from here to the hydrant system with outlets on the apron.



In 1958 the main runway was extended by 1,100 feet and work begun on a new terminal building. Due for completion next year, it will feature a two-pier layout providing apron accommodation for 20 aircraft, a concourse, restaurants and waiting rooms, and a new control tower. This last will have the latest radio and radar equipment, capable of dealing effectively with the increased air traffic of the future. Refuelling arrangements must be geared to meet the same demand. Here Esso is in its element. In collaboration with the airport staff, Esso engineers are designing a hydrant refuelling system of the latest type.



This model of the new terminal building at Manchester Airport clearly shows the southward extending piers with distinct allocation of areas to domestic and overseas traffic.

The advantages of a hydrant refuelling system, in which fuel is piped underground direct from storage tanks to hydrant outlets on the apron, are well known. But in this kind of system the need for careful design and far-sighted planning is even more vital than usual. The installation details of a hydrant system must be decided well in advance to avoid the expense of subsequent alteration.

Esso's engineers have ensured that Manchester Airport will incorporate the latest developments in design-thinking so that fuel, filtered for maximum purity, is delivered to the aircraft at the correct pressure with full safeguards to control pressure and flow-rate in all circumstances. As for far-sighted planning, it goes without saying that Esso engineers and Manchester Corporation have co-operated fully in this respect.

So it is that Esso's engineers are hard at work laying the foundation of a swift, safe service to meet the demands of the future, while Esso's refuelling crews meet those of the present. This is Esso's calculated hustle with a futuristic twist. At the airport of an inland city which has already brought the sea to its door — and in the same spirit is determined to harness the boundless potentialities of the air — Esso's calculated hustle could hardly be practised in a more suitable place.

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36 Queen Anne's Gate. London S.W.1
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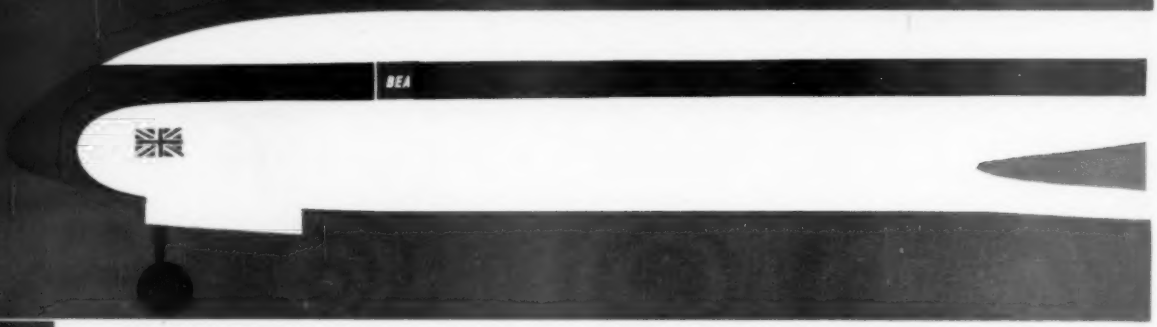
THE AEROPLANE
and ASTRONAUTICS
Advertisement

Already a busy airport — handling more than half a million passengers and over 32,000 aircraft movements a year — Manchester is gearing up for even more business.

Looking into the near future, an artist emphasises the "clean" appearance of the apron at Manchester Airport when the hydrant fuelling system is completed.

ROME ATHENS NICOSIA TEL AVIV ISTANBUL BEIRUT ZURICH COPENHAGEN



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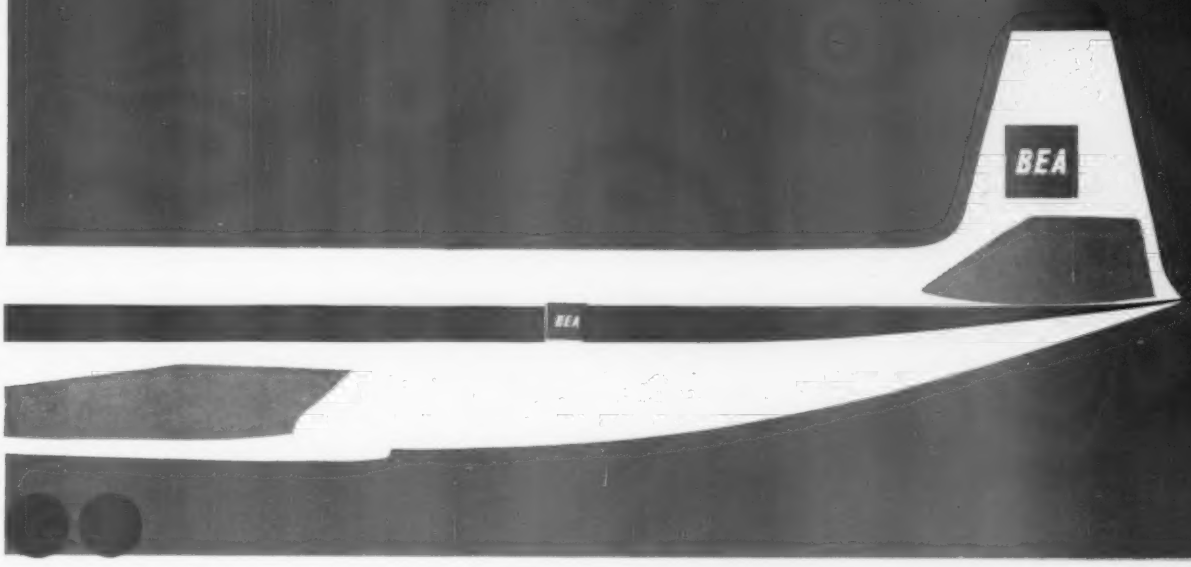


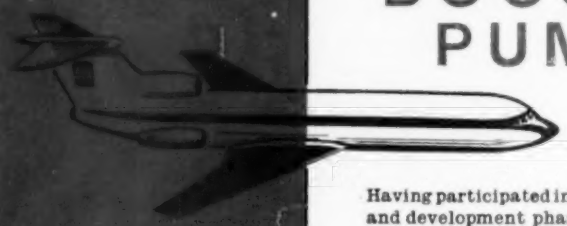
Big Jet for Europe

BY FOUR ROLLS-ROYCE JET ENGINES

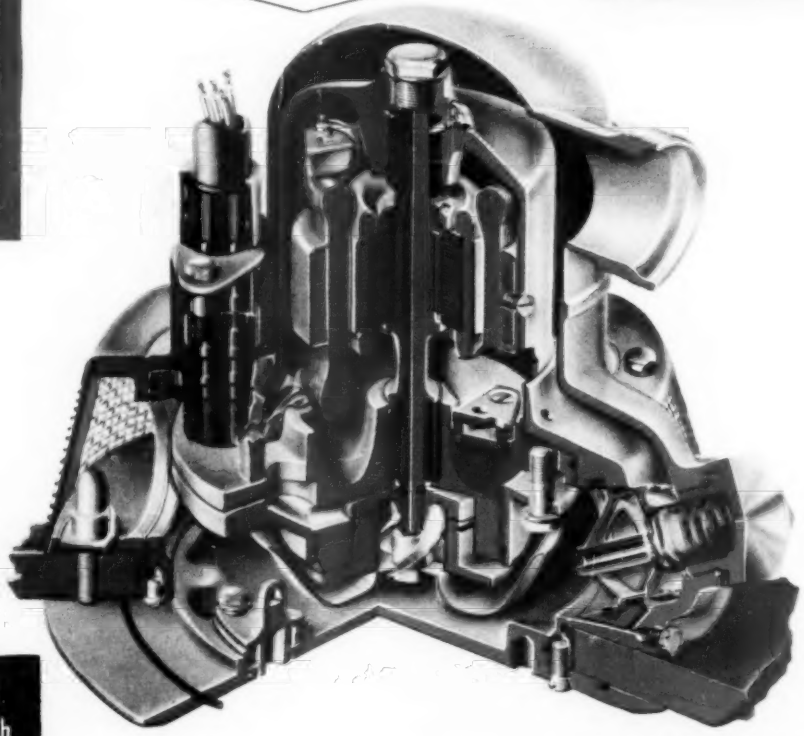
P E A N A I R W A Y S

Hobson

FUEL BOOSTER PUMPS



Having participated in many important research and development phases of aircraft and guided missile control, H. M. HOBSON LTD. are now expanding their activities in the fuel system field and have developed a tank-mounted fuel booster pump which is specified for the D.H. 121 Aircraft. The pump is driven from an A.C. electrical supply and being fully immersed requires no running seals.



S.B.A.C. Exhibition and Flying Display Farnborough Sept. 5th — 11th, 1960

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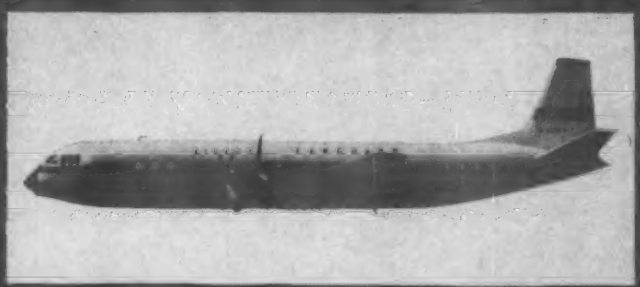
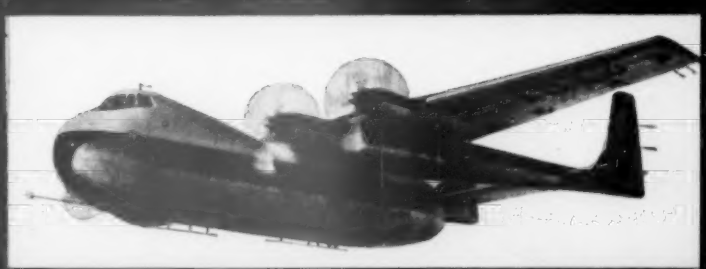


take the air...

H.D.A fly with them



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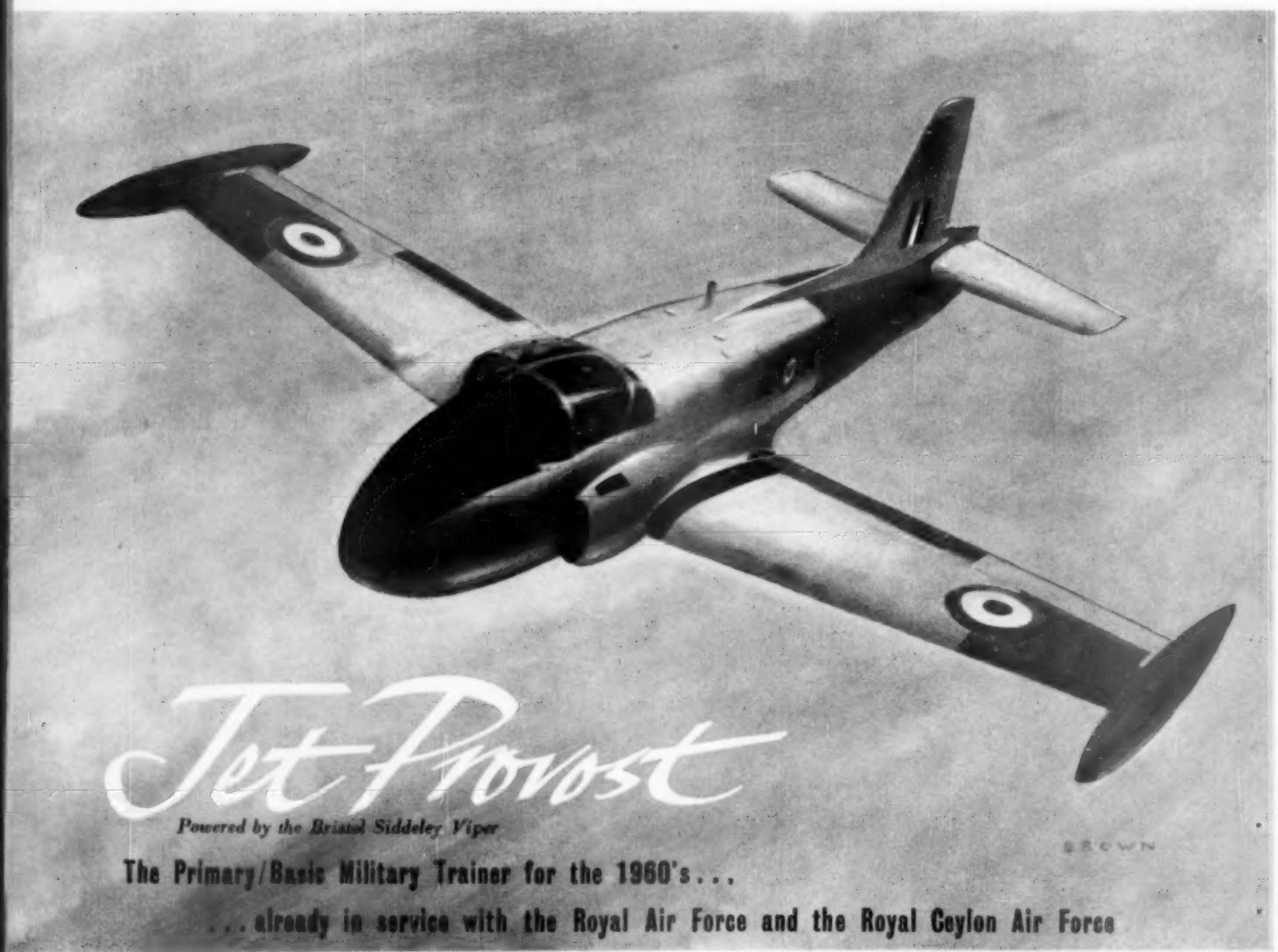
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BRITAIN'S AIRCRAFT INDUSTRY

New Groups for a New Decade

Britain's aircraft industry has seen major changes since the last S.B.A.C. Show. Its new structure is outlined below. Particulars of its aircraft, missile and aero-engine companies together with their products are given on the following pages. Under each company, the projects are discussed chronologically, the newest first.

FIRST steps towards strengthening the power of the British aircraft industry to compete in international markets can be traced back to May, 1958, when Mr. Aubrey Jones, then Minister of Supply, said that the volume of work available for the aircraft industry in future would support only three or four major airframe groups and two aero-engine groups. At that time the Government expected companies to develop new civil projects without any financial backing from the Treasury.

The movement towards the airframe groups began slowly, but accelerated after the Conservative Government was returned to office last October. Mr. Duncan Sandys was appointed Minister of Aviation and pursued a dynamic policy. Promises of Government support and a return to financial backing for selected civil projects accelerated amalgamation. Today, the bulk of the industry is concentrated into three airframe groups, one responsible for helicopters alone, and two major aero-engine companies.

The aim of the new groupings was to strengthen the financial and technical resources of manufacturers so that the industry could compete more effectively in export markets and could produce aircraft more rapidly.

The new shape of the industry is shown in the accompanying diagram. It includes the aircraft, missile and engine manufacturers which are ordinary members of the Society of British Aircraft Constructors. Particulars about the units composing each group will be found arranged alphabetically under group titles. In addition the following observations may be found helpful.

So far as **Hawker Siddeley Aviation, Ltd.,** is concerned, the recent take-overs represent the acceleration of a process which has gone on for many years. After its initial build-up as an aircraft group, Hawker Siddeley had greatly extended its industrial interests before returning to increase its stake in aviation by take-over bids.

In the past year the following companies have been taken over as wholly owned subsidiaries of the Hawker Siddeley Group:—Folland Aircraft, Ltd.; the Blackburn Group, Ltd., with all its daughter companies; and de Havilland Holdings, Ltd., with all the de Havilland subsidiaries in Britain and throughout the World.

Only the major Blackburn and de Havilland companies are shown in the diagram, but all their British and overseas subsidiaries are now also controlled by Hawker Siddeley.

The formation of **Bristol Siddeley Engines, Ltd.,** dates back to when Bristol Aero-Engines, Ltd., and Armstrong Siddeley Motors, Ltd., joined forces in April, 1958. Interests in Bristol Siddeley are held on a 50%-50% basis by the Hawker Siddeley Group, Ltd., and the Bristol Aeroplane Co., Ltd.

Interests in the **British Aircraft Corporation, Ltd.,** are held on a 20%-40%-40% basis respectively by the Bristol Aeroplane Co., Ltd., the English Electric Co., Ltd., and Vickers,

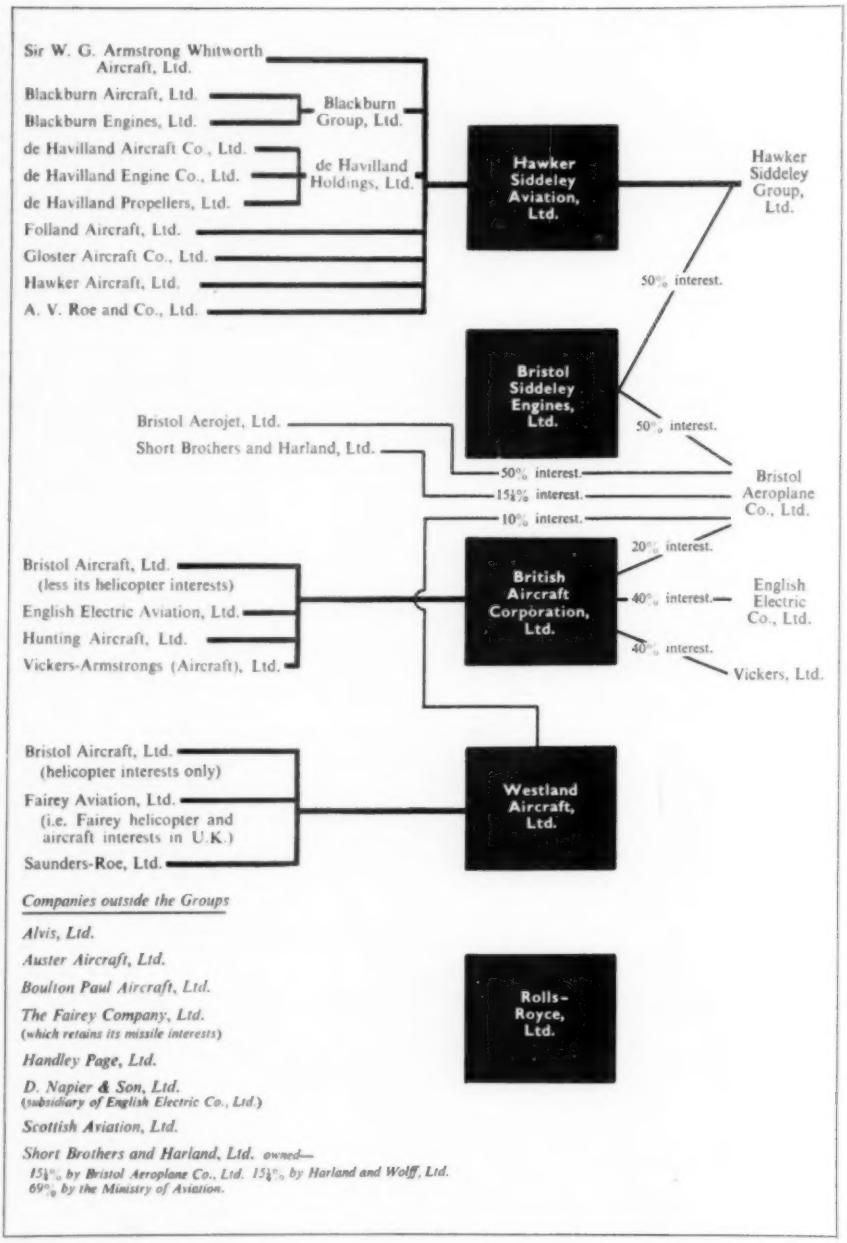
Ltd. Since the Corporation was announced in its original form, Hunting Aircraft, Ltd., has become its fourth subsidiary.

Two of the parent companies of the Corporation—the English Electric Co., Ltd., and Vickers, Ltd.—are large industrial concerns. The third, the Bristol Aeroplane Co., Ltd., is now largely an "aeronautical investment trust," with a 50% interest in Bristol Siddeley Engines, Ltd., a 10% interest in Westland Aircraft, Ltd., and a 15¼% interest in Short Brothers and Harland, Ltd. It also has a 50% interest in Bristol Aerojet, Ltd., and retains its former subsidiaries in Canada, Australia, New Zealand and Sweden as well as interests in French and Spanish companies. In Britain it owns Bristol Aircraft Holdings, Ltd., with two subsidiaries, Bristol Aircraft Services, Ltd., and Bristol Aeroplane Plastics, Ltd.

Not all the former activities of Bristol Aircraft, Ltd., come under the British Aircraft Corporation; its former helicopter division was sold by the Bristol Aeroplane Co. to Westland Aircraft, Ltd., and its former plastics activities come under a new company, Bristol Aeroplane Plastics, Ltd. As mentioned above, this is outside the B.A.C. group and is a direct subsidiary of the Bristol Aeroplane Co., Ltd.

Within the B.A.C. grouping the financial responsibility for types already in production will be directly attributed to the respective parent companies, but responsibility for projects will lie with the British Aircraft Corporation. As an example of this, English Electric orders for the Canberra and current marks of Lightning are directly accountable to the English Electric Co., Ltd., but later marks of Lightning and Thunderbird, the TSR-2 and the Blue Water missile will be related to the Corporation.

Westland Aircraft, Ltd., has made take-over bids for, or purchased directly, all the British companies involved in helicopter development. It has thus absorbed Saunders-Roe, Ltd., Fairey Aviation, Ltd., and the helicopter division of Bristol Aircraft, Ltd.


Sir W. G. Armstrong Whitworth Aircraft, Ltd.
Blackburn Aircraft, Ltd.
Blackburn Engines, Ltd.
Blackburn Group, Ltd.
de Havilland Aircraft Co., Ltd.
de Havilland Engine Co., Ltd.
de Havilland Propellers, Ltd.
de Havilland Holdings, Ltd.
Folland Aircraft, Ltd.
Gloster Aircraft Co., Ltd.
Hawker Aircraft, Ltd.
A. V. Roe and Co., Ltd.
Hawker Siddeley Aviation, Ltd.
Hawker Siddeley Group, Ltd.
50% interest.
Bristol Siddeley Engines, Ltd.
50% interest.
Bristol Aerojet, Ltd.
Short Brothers and Harland, Ltd.
50% interest.
15¼% interest.
10% interest.
Bristol Aeroplane Co., Ltd.
20% interest.
40% interest.
40% interest.
British Aircraft Corporation, Ltd.
English Electric Co., Ltd.
Vickers, Ltd.
Bristol Aircraft, Ltd. (less its helicopter interests)
English Electric Aviation, Ltd.
Hunting Aircraft, Ltd.
Vickers-Armstrongs (Aircraft), Ltd.
Bristol Aircraft, Ltd. (helicopter interests only)
Fairey Aviation, Ltd. (i.e. Fairey helicopter and aircraft interests in U.K.)
Saunders-Roe, Ltd.
Westland Aircraft, Ltd.
Companies outside the Groups
Alvis, Ltd.
Auster Aircraft, Ltd.
Boulton Paul Aircraft, Ltd.
The Fairey Company, Ltd. (which retains its missile interests)
Handley Page, Ltd.
D. Napier & Son, Ltd. (subsidiary of English Electric Co., Ltd.)
Scottish Aviation, Ltd.
Short Brothers and Harland, Ltd. owned—
15¼% by Bristol Aeroplane Co., Ltd. 15¼% by Harland and Wolff, Ltd.
69% by the Ministry of Aviation.
Rolls-Royce, Ltd.

As already mentioned, the helicopter division of Bristol Aircraft, Ltd., was bought from the Bristol Aeroplane Co., Ltd., in return for a 10% interest in Westland Aircraft, Ltd.

Fairey Aviation, Ltd., was bought from the Fairey Co., Ltd., but certain of its former activities have been retained by Fairey.

Saunders-Roe, Ltd., was taken over in its entirety apart from two industrial subsidiaries—Saunders-Roe (Anglesey), Ltd., and Saro Laminated Wood Products, Ltd.—which went to de Havilland and thus, in turn, now form part of the Hawker Siddeley group.

Through its size and uniquely powerful position in the aero-engine field, **Rolls-Royce, Ltd.,** qualifies for the title of "group," although it is a single company which has not been concerned in the "mergeritis" which has affected the industry as a whole.

No changes have been made in the affiliations of the other companies listed, but the following points are of interest:—

The Fairey Co., Ltd., has retained the hydraulic-power-control side of Fairey Aviation, Ltd.

Fairey aeronautical work in Britain now comes under Fairey Engineering, Ltd.; it includes responsibility in Britain for the Australian Malkara missile and Jindivik target aircraft. The Fairey Company retains all its aviation and industrial interests in Canada, Australia and Belgium.

D. Napier and Son, Ltd., remains a direct subsidiary of the English Electric Co., Ltd., and is unaffected by the formation of the British Aircraft Corporation.

Short Brothers and Harland, Ltd., in Northern Ireland is in a special position because a 69% interest is held by the Government. Mr. Sandys has said he did not seek to encourage an amalgamation affecting this company.

The Future

After the hectic days of late 1959 and early 1960 when the grouping negotiations were under way, the industry has had several months for consolidation and for internal re-organization to make the new arrangements as effective as possible. This is a continuing process and much remains to be done.

But basically the shape of the industry is now clear. Some of the companies which are still independent may affiliate themselves with the groups; the groups may tie up some loose ends inherent in their present form.

The ball lies at their feet.

BRITISH AIRCRAFT CORPORATION, LTD.

100 Pall Mall, London, S.W.1

THIS is one of the three major airframe groups of the industry. Its member companies are Bristol Aircraft, Ltd. (less its helicopter interests, which now form part of the Westland group); English Electric Aviation, Ltd.; Hunting Aircraft, Ltd.; and Vickers-Armstrongs (Aircraft), Ltd. The parent companies, which own a 20%-40%-40% interest in the Corporation, are, respectively, the Bristol Aeroplane Co., Ltd., the English Electric Co., Ltd., and Vickers, Ltd.

Financial responsibility for most projects which were under way before the merger remains with the original parent companies. New projects come under financial control of the British Aircraft Corporation; these include the supersonic TSR-2 strike aircraft, the BAC-107 (ex-Hunting 107) short- and medium-range transport, the Swallow variable-geometry supersonic aircraft and design studies for supersonic transports.

Bristol Aircraft, Ltd.

Filton House, Bristol

MEMBER of the British Aircraft Corporation, this company employs about 8,000 people and has factories at Filton and Cardiff with a total floor area of just over two million sq. ft. Its major production efforts at Filton and Cardiff are devoted to Bristol/Ferranti Bloodhound SAMs and their launchers; this missile system is on order for the R.A.F., Sweden and Australia. The company is no longer concerned with helicopter development and production; this section of its former activities is now part of the Westland group.

Other company work includes construction of the Bristol 188 supersonic research aircraft and the production of wings for the Short Britannic freighter. Major Britannia overhauls are done for Canadian Pacific Airlines and other operators.

Bristol design teams are located at Filton and there is an aircraft drawing office at Bournemouth. The company has several projects which cannot be revealed for security reasons; it is working on an advanced version of the Bloodhound as well as Bristol 188 development.

BRISTOL 188.—Expected to make its first flight next year, this supersonic research aircraft has a welded stainless-steel structure. It is intended for research at speeds above 1,500 m.p.h. (Mach 2.3 in the stratosphere). A large single-seater, it is powered by two de Havilland Gyron Junior DGJ.10 turbojets with variable reheat. Maximum static thrust is 10,000 lb. per engine, which is increased to 14,000 lb. by the 2,000° K. reheat system. Two flying examples of the 188 are to be built in addition to a structural-test specimen which was moved to Farnborough earlier this year.

BRISTOL/FERRANTI BLOODHOUND.—This ramjet-propelled surface-to-air missile is in production for the Royal Air Force and export orders have been received from Sweden and Australia. It is operational with No. 264 Squadron at North Coates in Lincolnshire, and at other R.A.F. stations in eastern England. Powered by two 16-in. Bristol Siddeley Thor ramjets, Bloodhound probably has a slant range of more than 60 miles. The guidance system, by Ferranti, relies on semi-active radar homing; the target is illuminated by a B.T.H. Sting Ray ground radar. A more advanced version with greater lethality, range and ceiling is under development.

English Electric Aviation, Ltd.

Marconi House, Strand, London, W.C.2

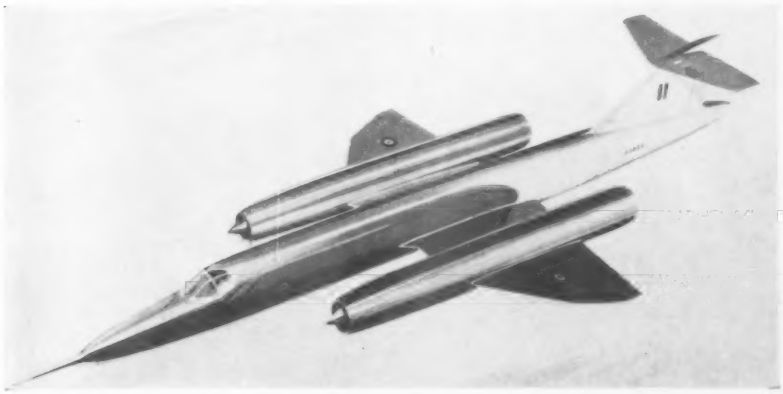
RESEARCH, design and development of aircraft, missiles and guidance systems are handled by this British Aircraft Corporation company. Production is done under contract by the English Electric Co., Ltd. The English Electric development and production companies employ 15,000 people on design, development and production of aircraft and guided weapons.

The research, design and development facilities of the company's aircraft division are at Warton aerodrome in Lancashire,

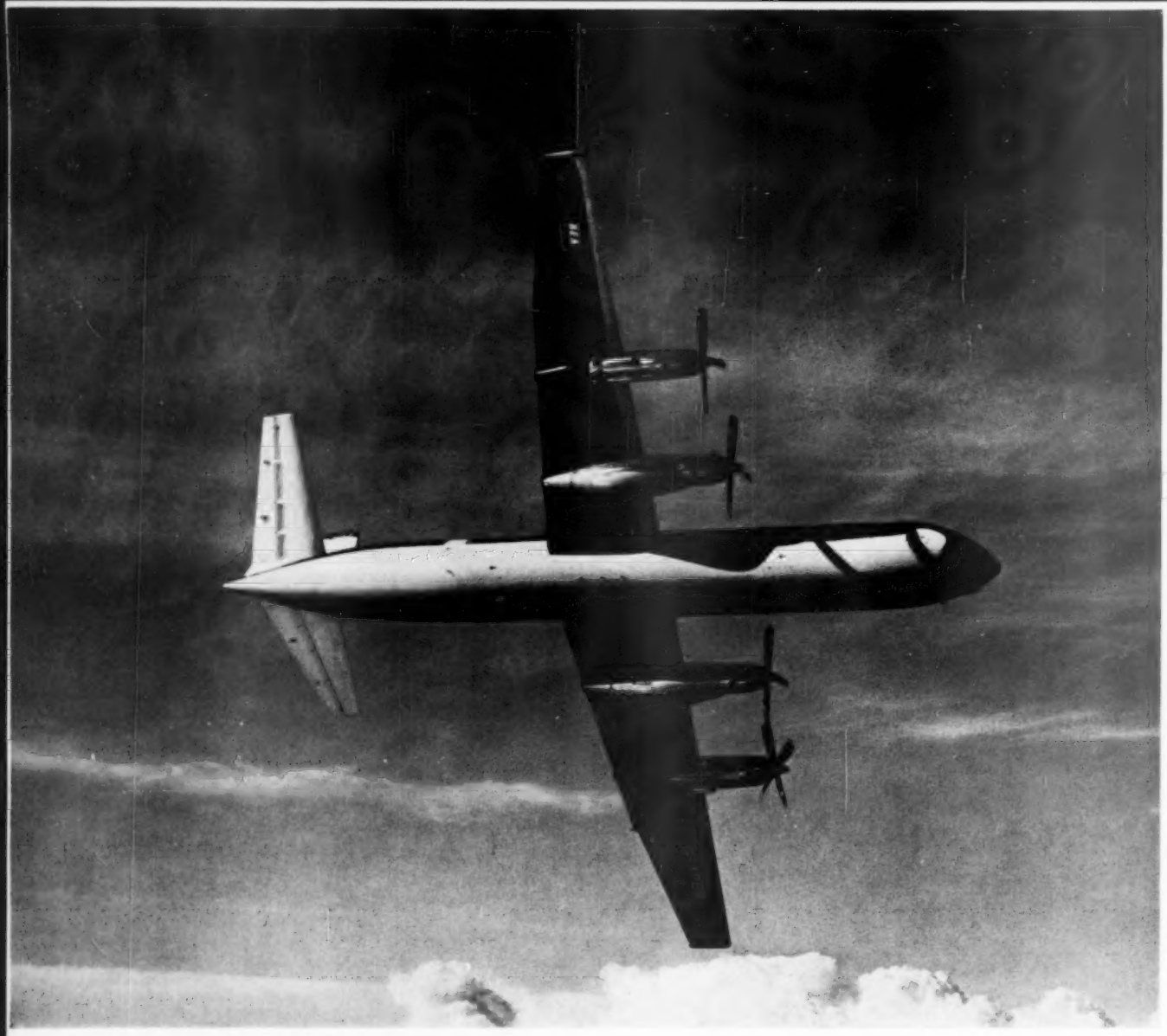
(*Continued on page 288*)

British Aircraft Corporation 107 short-haul jet transport (two Bristol Siddeley BS.75s).

Bristol/Ferranti Bloodhound surface-to-air missile on launcher (two Thor ramjets).

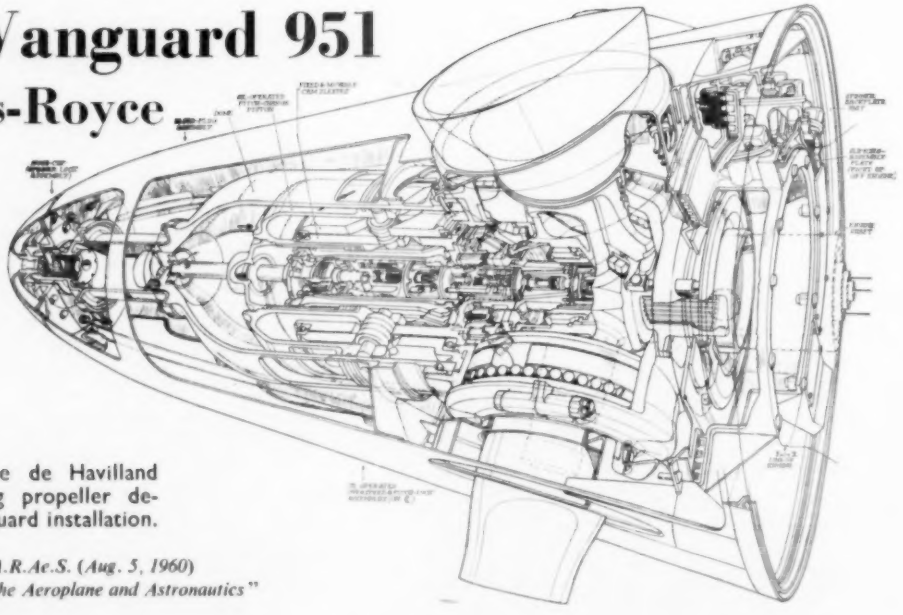


Bristol 188 all-steel supersonic research aircraft (two D.H. Gyron Juniors).



Vickers Vanguard 951

(Four Rolls-Royce Tynes)



Internal features of the de Havilland feathering and reversing propeller designed for the Tyne-Vanguard installation.

Drawing by J. H. Clark, A.R.Ae.S. (Aug. 5, 1960)

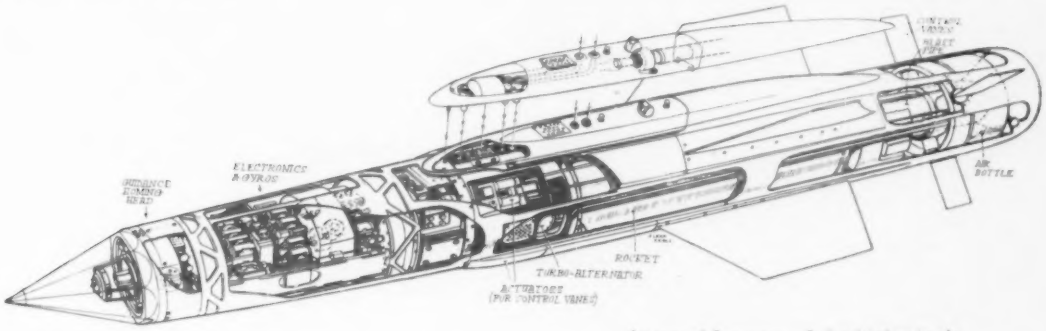
Copyright "The Aeroplane and Astronautics"

English Electric Lightning

(Two Rolls-Royce Avons)

armed with

D.H. Firestreak



Drawing by J. H. Clark, A.R.Ae.S. (Feb. 26, 1960).
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Internal features of the Lightning's principal armament, the de Havilland Firestreak air-to-air guided missile. Below are a Lightning T.4 (foreground) and an F.1 interceptor.

British Aircraft Corp., Ltd. . . . .

(*Continued from page 285*)

where the Lightning supersonic interceptor is under development. The Lightning F.1 and T.4 aircraft are built at the Preston and Accrington factories of English Electric, with final assembly at Samlesbury. The Canberra bomber remains in limited production.

The E.E. missile division has establishments at Luton and Stevenage. Missiles under development include the Thunderbird mobile SAM and the Blue Water corps-support weapon, both of which are to be produced for the British Army. The missile division is also developing instruments and inertial-navigation systems which use Minneapolis-Honeywell gyros built under licence. Its design team is based at Stevenage.

A major project of the aircraft division is the development, in collaboration with Vickers-Armstrongs, of the TSR-2 supersonic strike and reconnaissance aircraft. A combined TSR-2 design team of English Electric and Vickers personnel is based at Weybridge. (See also Vickers.)

Other English Electric projects include research and design work on supersonic and VTOL types.

TSR-2.—This supersonic strike and reconnaissance aircraft for the R.A.F. is being developed jointly by English Electric Aviation and Vickers-Armstrongs (Aircraft). The original specification was for a "Canberra replacement," but the precise rôle of the TSR-2 has recently been under review. It is to enter service in 1964-5 and will carry nuclear weapons and air-to-air missiles. The aircraft will be powered by advanced Bristol Siddeley Olympus engines with reheat and is designed for supersonic operation at both low and high levels.

BLUE WATER.—This corps-support missile is under development for the British Army to replace the Corporal SSM. It is a solid-propellent missile with inertial guidance and a nuclear warhead. Anglo-German talks at government level have aimed at joint development of the missile, with the intention that it should be adopted by NATO.

LIGHTNING.—Britain's first supersonic fighter, the Lightning, is in production for the R.A.F. No. 74 Squadron at Coltishall is the first Fighter Command unit to equip with the aircraft, following extended trials at other R.A.F. establishments and with the Air Fighting Development Squadron at Coltishall. Armament of the Lightning comprises two nose-mounted 30-mm. Aden cannon and two de Havilland Firestreak AAMs mounted on the side of the fuselage nose. A fuselage pack which contains 48 2-in. rocket projectiles can also be installed. A two-seat trainer version, the T.4, is also in production. The Lightning F.1 is powered by 14,430-lb.-thrust Avon RA24Rs, but later models are expected to have the R.B.146 Avon 300 series engine rated at 13,220 lb. dry.

THUNDERBIRD.—The Mk. 1 version of this surface-to-air missile is in limited service with the British Army; a more advanced type with a higher performance and more effective guidance is being developed. Designed as a mobile anti-aircraft missile, Thunderbird has a solid-propellent sustainer motor. Semi-active radar homing is used.

CANBERRA.—Production of the Canberra is now almost at an end in the English Electric factories at Warton and Samlesbury after more than 10 years. Since the Canberra first flew in May, 1949, English Electric has produced the B. Mks. 2 and 6, B(I) Mk. 8, P.R. Mks. 3 and 7, and T. Mk. 4 for the R.A.F. and export versions for Ecuador, France, India, New Zealand, Peru, Rhodesia, Sweden and Venezuela. The T. Mk. 11 radar trainer conversion is supplied by Boulton Paul. Short Bros. and Harland, Ltd., is producing the P.R. Mk. 9 and converts Mk. 2s into U. Mk. 10 target drones.

Hunting Jet Provost primary trainer (one Bristol Siddeley Viper).

Photographs copyright "The Aeroplane and Astronautics"

English Electric Thunderbird surface-to-air missile on launcher (one solid-propellent rocket motor).

Hunting Aircraft, Ltd.

Luton Airport, Beds

A MEMBER of the British Aircraft Corporation group, this company employs 2,000 people and has a total plant area of 500,000 sq. ft. Its factory and main design team are at Luton; it has an additional design team in London.

Current production centres on Jet Provost T.3 and T.4 basic trainers. The company is also responsible for design and production of the outer wing for the D.H.121 jet transport.

Projects include the BAC-107 short- and medium-range jet transport. Originally a Hunting project, this is now being developed under the ægis of the British Aircraft Corporation as a whole. Other Hunting R. and D. work is being done under Ministry of Aviation contracts; this includes work on a jet-flap research aircraft.

HUNTING BAC-107.—This design for a small, short-haul jet transport which has been studied by the Hunting design team for several years now, ranks as one of the principal new civil projects of the British Aircraft Corporation. The layout has rear-mounted engines, a T-tail and a low, moderately swept wing. Accommodation would be for 50-59 passengers and optimum range between 700 and 1,000 naut. miles. A military version is of interest to the R.A.F. as a Valetta and Varsity replacement.

JET-FLAP RESEARCH AIRCRAFT.—Under Ministry of Aviation contract, Hunting Aircraft is developing a jet-flap research aircraft. No details about this project are available. It will allow full-scale tests to be made of the jet-flap principle developed by the National Gas Turbine Establishment in which the efflux of a propulsion jet engine is ejected through a narrow slit along the trailing edge of the wing.

JET PROVOST.—As the new basic trainer for the R.A.F., the Jet Provost T. Mk. 3 is Hunting's principal product. Present orders are for about 100, with further contracts to be placed. The T. Mk. 4, with a 2,500-lb. Viper 200 and 20% improvement in performance, may also be ordered. Ceylon has bought six armed Jet Provost T. Mk. 51s.

Vickers-Armstrongs (Aircraft), Ltd.

Weybridge, Surrey

MAIN research, design and production facilities of this British Aircraft Corporation company are at Weybridge. It also has a design team and factory at Hurn. The former Supermarine factory at South Marston no longer belongs to this company and is outside the British Aircraft Corporation. It now comes under a new company, Vickers-Armstrongs (South Marston), Ltd., whose activities include development and production of research reactors, reactor simulators and hovercraft.

At Weybridge, Vickers-Armstrongs (Aircraft) are building Vanguard turboprop airliners and Viscount 810s; production work is also under way on the VC10 long-range transport. At Hurn, detail parts and sub-assemblies for the Vanguard and VC10 are produced. Development of the Vigilant wire-guided anti-tank missile is also centred at Weybridge.

Projects include the development of the Super VC10 transport, which is on order for B.O.A.C.; freighter versions of VC10 and Vanguard; and the TSR-2 strike and reconnaissance aircraft which is being developed in collaboration with English Electric. In conjunction with the Ministry of Aviation, work continues

on the Swallow variable-geometry aircraft, which is now under the ægis of the British Aircraft Corporation.

TSR-2.—For information about this joint development by Vickers-Armstrongs (Aircraft) and English Electric Aviation see the note on page 288.

VC10.—First of a family of subsonic transports, the VC10 is the largest civil project in the European aircraft industry. Developed to a B.O.A.C. specification, the Conway-engined VC10 takes full advantage of a rear-engined layout to obtain better airfield performance and cruising cost than achieved by the first-generation jets now in service. The B.O.A.C. contract for 35 VC10s is worth over £90 million (including engines, spares and associated ground equipment), and the Government is to share the financial risk of further development and production of this type.

SUPER VC10.—Second member of the VC10 family, the Super VC10 has a lengthened fuselage to accommodate up to 212 passengers, and at 347,000 lb. is the heaviest jet transport ordered to date. A B.O.A.C. contract for 10, valued at some £25 million without spares was signed in June. Further developments include the use of a still longer fuselage, increased fuel capacity and later Conways of lower s.f.c. to give greater range. A pure freighter with swing-nose loading based on this variant has a take-off weight of 373,000 lb. and a payload of 106,000 lb.

VC11.—Another project in the VC10 family, the VC11 has been designed for best possible economy on medium-range operations of 500 to 2,000 miles. Its features include a large-diameter fuselage for comfortable six-abreast seating, small wing area with leading edge-flaps and blown trailing-edge flaps, and four 11,000-lb. s.t. R.B.163 engines. Accommodation is for 100-135 passengers; gross weight, 170,000 lb.; and typical cruising speed, 510-520 knots.

VANGUARD.—Sales total stands at 43, for B.E.A. and T.C.A. These aircraft are now expected to go into service early next year and cover both Vanguard I (135,000 lb.) and Vanguard II (146,500 lb.) types. To take advantage of the recent increase in gross weight to 146,500 lb., new Vanguard variants are being studied, including various freighters with or without rear-loading and carrying payloads of up to 64,000 lb.

VIGILANT.—This small wire-guided anti-tank missile has been developed by the company as a private venture. Its launching weight is 26 lb. and it carries a 6-lb. warhead over a range of about one mile. It is currently being developed to give a greater destructive effect and a small production batch has been ordered.

Vickers Super VC10 long-range transport (four Rolls-Royce Conways).

SCIMITAR F.1.—Production of the (Vickers Supermarine) Scimitar single-seat carrier-borne fighter/strike aircraft for the Royal Navy is scheduled to end in September at South Marston; a total of about 100 are believed to have been ordered. All squadrons scheduled to receive Scimitars have now been re-equipped with the type.

VISCOUNT.—Production of Viscounts continues at Weybridge against airline orders. Total sales now stand at 423 with about 10 to be delivered, and there is a brisk market in second-hand Viscounts.

HAWKER SIDDELEY AVIATION, LTD.

Richmond Road, Kingston-on-Thames, Surrey

ONE of the three large British airframe groups, its member companies are Sir W. G. Armstrong Whitworth Aircraft, Ltd.; Blackburn Group, Ltd., and its subsidiaries, of which the leading ones are Blackburn Aircraft, Ltd., and Blackburn Engines, Ltd.; de Havilland Holdings, Ltd., and its subsidiaries which include the de Havilland Aircraft Co., Ltd., the de Havilland Engine Co., Ltd., and de Havilland Propellers, Ltd.; Folland Aircraft, Ltd.; the Gloster Aircraft Co., Ltd.; Hawker Aircraft, Ltd.; and A. V. Roe and Co., Ltd.

In its turn Hawker Siddeley Aviation is a subsidiary of Hawker Siddeley Group, Ltd., which has extensive interests outside aviation.

Sir W. G. Armstrong Whitworth Aircraft, Ltd.

Baginton, Coventry

APPROXIMATELY 10,000 people are employed by Armstrong Whitworth at its Baginton, Whitley, Bitteswell and Hucclecote factories. At Baginton the Sea Hawk, Argosy civil freighter and A.W.660 military transport are in production. Sub-contract work is also done for the Avro Vulcan bomber and Avro 748 transport. Nearing completion is sub-contract production for the Bristol 188 supersonic research aircraft. The Armstrong Whitworth Rolamat cargo-handling system is also produced there.

Whitley is the design and research centre for both aircraft and missiles. The Seaslug surface-to-air missile for the Royal Navy is also produced there and it is the base of the company's electronics organization.

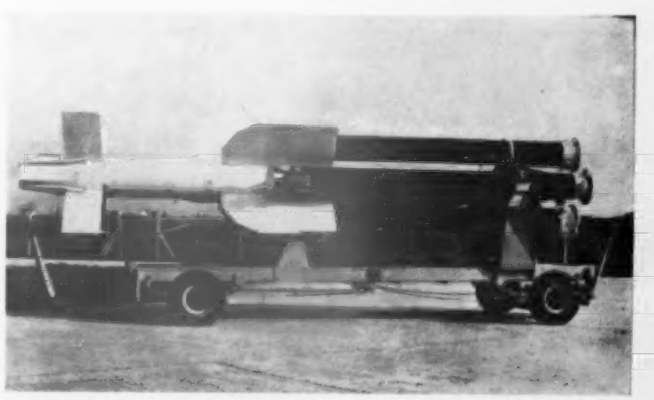
Bitteswell is the final assembly and test centre for all Armstrong Whitworth aircraft.

Hucclecote, in Gloucestershire, is the home of Armstrong Whitworth Equipment, whose main product is fuel-system equipment for aircraft. Among aircraft types using A.W.E. fuel-system equipment are the Britannic, Lightning, Gannet and Javelin. The unit markets a wide variety of secondary products of Hawker Siddeley Aviation; it specializes in pneumatic, hydraulic and electronic equipment. A commercial version of the Rolamat rapid-loading system is also produced.

In addition to the Argosy and A.W.660, Armstrong Whitworth projects include the A.W.670 car-ferry/airbus. It is also making studies of VTOL and STOL projects and supersonic transports.

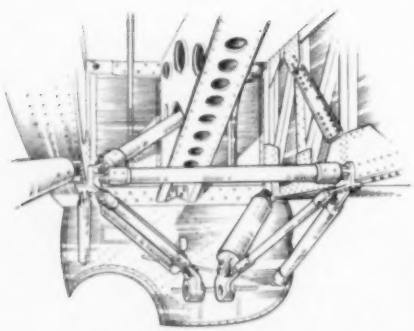
A.W.660.—The R.A.F. has ordered 40 of this military version of the Argosy, the first of which is to fly later this year. Its features are an increased weight, Dart R.Da.8 engines and a "beaver" tail which can be opened in the air for paradropping. These rear doors are at present being flown on the second Argosy, G-APRL, which will later revert to full civil standard.

(*Continued on page 292*)



Armstrong Whitworth Seaslug ship-to-air missile (one solid propellent rocket).

Armstrong Whitworth A.W.650 Argosy (Four Rolls-Royce Darts)



Details of the main undercarriage bay structure.

Drawings by R. J. Way. (Nov. 21, 1958).
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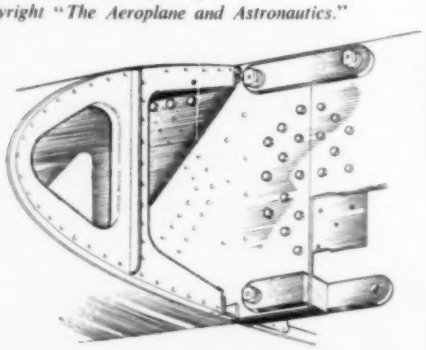
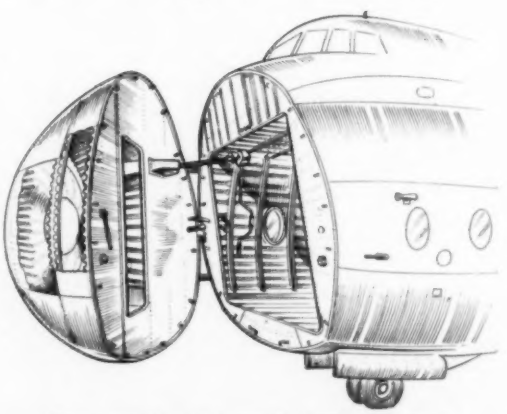


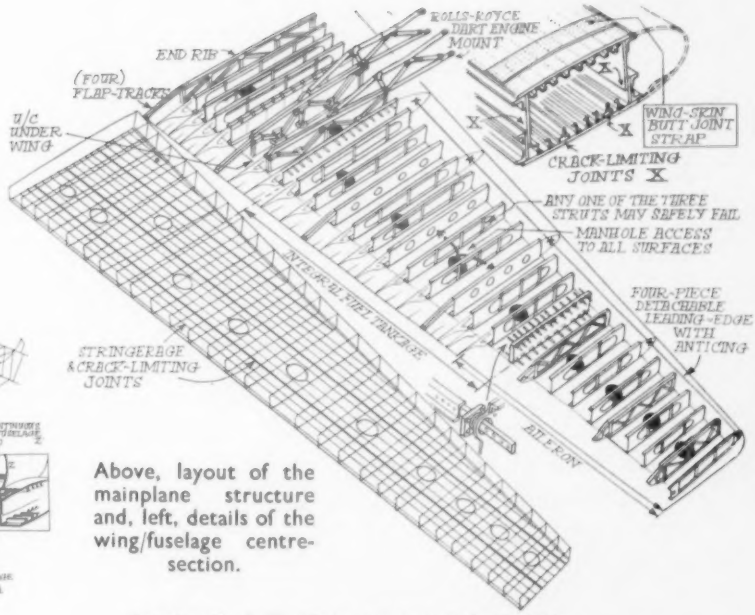
Intermediate-wing/ outer-wing joint at the front spar.

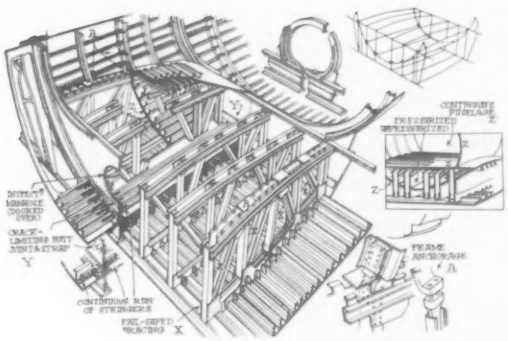


The nose of the Argosy's fuselage hinges to form the main loading door.

Avro 748

(Two Rolls-Royce Darts)





Above, layout of the mainplane structure and, left, details of the wing/fuselage centre-section.

Drawings by J. H. Clark, A.R.Ae.S. (Feb. 12, 1960).

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Hawker Siddeley Aviation, Ltd. . . . .

(*Continued from page 289*)

ARGOSY.—Developed as a private venture on which the company has already spent more than £3 million, the Argosy is among the civil aircraft which the Government is to help to finance in future. Six of an initial batch of ten Argosies have to date flown more than 2,000 hr., and deliveries will begin shortly, following the grant of an unrestricted British C. of A. Contracts now being negotiated cover delivery of the first ten aircraft, Riddle Airlines and B.E.A. being among the airlines concerned.

SEASLUG.—This beam-riding ship-to-air missile has been developed for the Royal Navy and is in production for the "Hampshire"-class super destroyers. It has four wrap-round boosters and a solid-propellent sustainer motor. Contractors for control and guidance equipment are G.E.C. and Sperry respectively.

SEA HAWK.—An original Hawker design, the Sea Hawk has for many years been the responsibility of Armstrong Whitworth, which has built over 500 for the Royal Navy, Royal Netherlands Navy, and German Navy. A final batch of 24 for the Indian Navy is now in hand.

Blackburn Aircraft, Ltd., and Blackburn Engines, Ltd.

Brough, Yorkshire

TOTAL Blackburn employees at Brough are approximately 5,500. The research, design and development facilities of the Blackburn aircraft and engine companies are centred there, although the company also has design offices in London and Leeds. Its NA.39 naval strike aircraft are test-flown at Holme-on-Spalding Moor airfield.

Work at Brough includes the overhaul of Beverley transports and the production of the NA.39, engines and electronic equipment. Power units produced include the A.129 Nimbus turboshaft, Palouste air-turbine starters and Artouste airborne auxiliary power units.

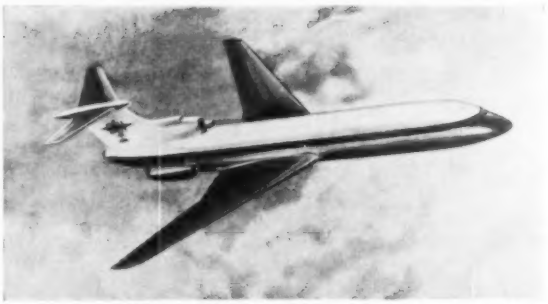
No details can be given of Blackburn project and development work, but this undoubtedly includes advanced new versions of the NA.39. Other projects which have been mentioned include a small piston-engined transport and a giant helicopter, information on which is given below.

SP 60.—Although only in the formative stages of project study, the SP 60 has recently gained some publicity as the largest helicopter project in Britain. Originated by Blackburn, it is under review by the Hawker Siddeley Advanced Projects Group. A large diameter six-blade rotor would be used, with six vertically mounted gas producers in the rotor head. This vertical-lift power unit would lift a gross weight of about 135,000 lb., including such loads as a 250-passenger pod, or 18-car and 90-passenger container.

NA.39.—In production for the Royal Navy, the Blackburn NA.39 is a carrier-borne low-level strike aircraft designed to deliver nuclear weapons at high subsonic speed. Air bled from its Gyron Junior engines is used for boundary-layer control blowing over its wing and tail surfaces. Its tail can split to form air brakes; these are fully opened and its fuselage nose folded to allow it to use standard carrier deck-lifts.

A.129 NIMBUS.—This 968-s.h.p. turboshaft is in production for Westland Sprite helicopters on order for the British Army. (This helicopter was formerly known as the Saunders-Roe P.531 Wasp.) It also powers the Westland Sea Sprite, which is the version of the helicopter being developed for the Royal Navy, and will be used in the SRN-2 Hovercraft.

TURMO.—This 425-s.h.p. shaft turbine powers the original evaluation batch of P.531 helicopters for the Royal Navy, and an experimental Skeeter.



de Havilland Trident (three Rolls-Royce R.B.163 engines)

de Havilland Holdings, Ltd.

Great Nast Hyde, St. Albans Road, Hatfield, Herts

NOW a wholly owned Hawker Siddeley subsidiary, de Havilland Holdings is the parent company of the de Havilland group. Through de Havilland Holdings, the Hawker Siddeley Group now owns all the D.H. subsidiaries, which are the de Havilland Aircraft Co.; the de Havilland Engine Co.; de Havilland Propellers; the de Havilland aircraft companies of Canada, Australia, South Africa and New Zealand; and de Havilland Aircraft Inc. (U.S.A.).

In all, 37,000 people are employed by the de Havilland companies, 4,000 overseas and 33,000 in the aircraft, engine and propeller companies in Britain.

de Havilland Aircraft Co., Ltd.

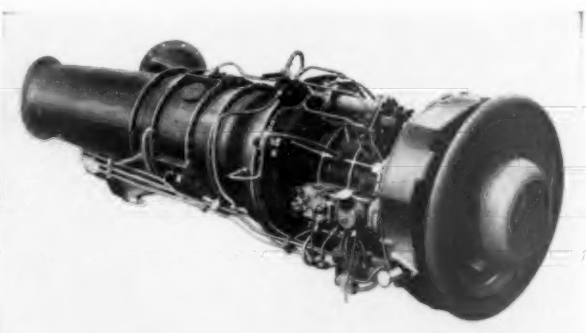
Hatfield, Herts

IN production at the de Havilland factories at Hatfield, Chester and Christchurch are the Comet 4 airliner, Sea Vixens for the Royal Navy, Herons and Doves. Construction of the D.H.121 Trident jet transport is now beginning; this aircraft is on order for British European Airways.

TRIDENT.—Scheduled to fly at the end of next year, the D.H.121 meets the B.E.A. requirement for a short-haul jet and as one of the major British civil projects qualifies for Government financial backing. The initial B.E.A. order is for 24, with an option on 12 more. This version, with 10,100 lb. s.t. R.B.163-1 by-pass engines, is optimized for stage lengths of 800 naut. miles carrying up to 100 passengers. A Mk. 2 is under development, for longer stages. Following the inclusion of de Havilland in the Hawker Siddeley Group, the 121 has become entirely a D.H. project, and the Airco consortium, including Fairey and Hunting, has been dissolved.

SEA VIXEN FAW.1.—This two-seat all-weather carrier-based fighter has been in service with the Royal Navy since July, 1959. Powered by two Rolls-Royce Avons, it is supersonic in a shallow dive. Standard interception armament is four Firestreak AAMs mounted under the wings plus 28 two-inch rockets in two retractable packs under the nose. For strike and reconnaissance duties the Firestreaks can be replaced by a variety of stores including bombs, rockets and fuel tanks.

COMET.—A steady trickle of orders keeps the Comet in production, and negotiations are continuing with other interested operators. The full fleet of 19 Comet 4s has been delivered to B.O.A.C.; other operators of this version are Aerolineas Argentinas, which has had



Above, Blackburn A.129 Nimbus free turbine helicopter engine.

Left, Blackburn NA.39 strike aircraft (two D.H. Gyron Juniors).

six, and East African Airways, starting service with two later this month. The Comet 4B is the version for B.E.A. and Olympic Airways, with a total of 14 on order. Mexicana, Misrair and Middle East Airlines have ordered the Comet 4C. Orders for all versions of the Comet 4 at present total 51.

HERON.—Production of this four-engined transport continues at a low rate at Chester to meet airline and executive orders. About 140 have been built to date, the current production version being the Mk. 2 with retractable undercarriage.

DOVE.—In the past 15 years, de Havilland has sold 520 Doves, and the type is still in production at Chester for the executive market. Latest versions are the Dove 7 and Dove 8, respectively standard and executive models with 400 h.p. Gipsy Queen 70 engines, ejector-type exhaust and Heron-type canopies. For the U.S. market, the Dove 8A is known as the Dove Custom 800.

Folland Gnat trainer (one Bristol Siddeley Orpheus).

de Havilland Engine Co., Ltd.

Leavesden, nr. Watford, Herts

THIS company employs more than 5,500 people; its main production plant has an area of nearly one million sq. ft. Its production and business divisions are at Leavesden and its design and development headquarters at Stag Lane, where its engineering and rocket divisions are based. The company's engine-test facilities are at Hatfield.

Non-aeronautical work is done by the company's industrial products division which is based at Leavesden. There is also a nuclear power group with its technical headquarters in London; this is producing equipment for the HERO and PLUTO reactors.

Current production of aircraft engines includes the Gipsy Major and Gipsy Queen series of in-line air-cooled piston engines; the Gnome H.1000 turboshaft; the Gyron Junior DGJ.2 Mk. 101 turbojet; and the Spectre DSpe.4 assisted take-off rocket motor.

The existing range of engines is being further developed as detailed hereafter:—

GNOME.—This is a licence-built version of the General Electric T58 turboshaft. The 1,000 s.h.p. Gnome H.1000 is in production to re-engine R.A.F. Whirlwind helicopters. A 1,250-s.h.p. version, the Gnome H.1200, is under development as a helicopter power-plant. A turboprop version of the engine, the P.1000, is expected to make its first run soon. A coupled version of the H.1200 is being developed to power the Wessex 2 helicopter.

GYRON JUNIOR.—The 7,100 lb. s.t. DGJ.2 Mk. 101 version of this engine is in production as the power unit for the Blackburn NA.39 naval strike aircraft. The DGJ.2 has been designed to allow for considerable air bleed when high-lift boundary-layer control is in operation. The DGJ.10 is a supersonic version of the Gyron Junior with a 2,000° K. reheat system; it will power the Bristol 188 research aircraft. Later versions of the Gyron Junior are under development.

SPECTRE DSpe.4.—This fixed-thrust HTP/kerosene rocket motor is in production as an assisted take-off unit for V-bombers. Production has now ended of the Double Spectre which powers full-scale test vehicles of the Avro Blue Steel stand-off bomb.

GIPSY QUEEN.—Queen 70 and 30 in-line piston engines remain in production. A 400 h.p. Mk. 3 version of the Queen 70 has been produced for the Dove 8 and the engine is expected to be further uprated in future.

de Havilland Gyron Junior 101 turbojet for the Blackburn NA.39.

GIPSY MAJOR.—This is being produced in its Mk. 140 form for military Skeeter helicopters; a turbo-supercharged version, the Mk. 215, is also available and its development is continuing.

de Havilland Propellers, Ltd.

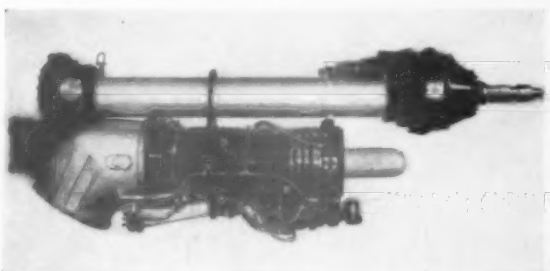
Hatfield, Herts

WITH factories at Hatfield, Stevenage, Lostock, Farnworth and Lakefield, this company produces propellers, mainly for Tyne- and Eland-engined aircraft; air-conditioning equipment for such aircraft as the Victor, Sea Vixen, Lightning, Scimitar, Comet, Trident and Britannic; alternators for missiles, including Firestreak, Seaslug and Bloodhound; aero-engine fuel-control equipment; scanners; de Havilland Pottermeter flow-meters for measuring the flow of any fluid; and automatic control equipment including process-control computers and data-acquisition and monitoring equipment.

On the missile side, the company is producing the Firestreak air-to-air missile for the Royal Navy and R.A.F. It is also developing an advanced air-to-air missile known as Red Top under Ministry of Aviation contract.

Following cancellation of the Blue Streak LRBM as an operational missile and pending a Government decision on its future as a space launcher, work continues on those aspects of the project which are applicable to its use as a satellite vehicle.

RED TOP.—An advanced air-to-air missile now under development, Red Top is probably the "improved" missile which, according to the Minister of Defence, will, in due course, be carried by Lightning fighters in place of Firestreak. It probably uses infra-red guidance, and may well be the missile which has been referred to as Firestreak Mk. 4.

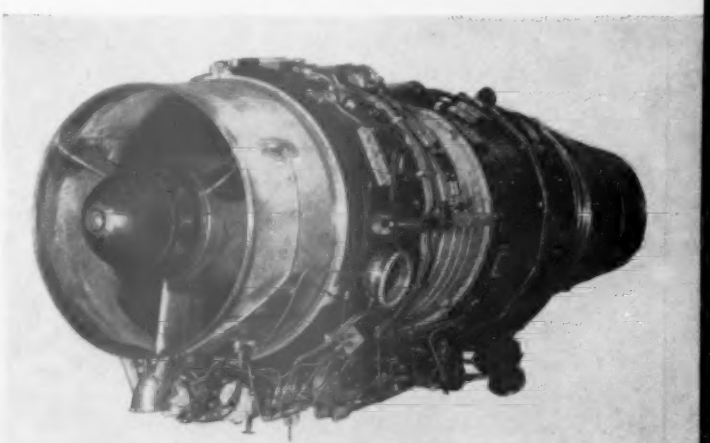


de Havilland Gnome turboprop variant for feeder-liners.

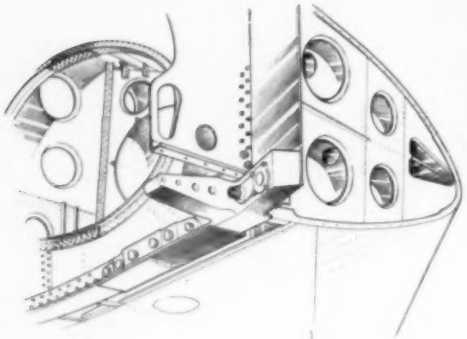
FIRESTREAK.—This infra-red-homing air-to-air missile is in service with the Royal Navy and R.A.F. Four Firestreaks are carried by the Sea Vixen and Javelin, and two by the Lightning. The missile has fixed cruciform wings and cruciform control fins. It is propelled by a solid rocket with a short burning time. Firestreak homes on the engine jet-pipes of its target; the warhead is exploded by an infra-red proximity fuse.

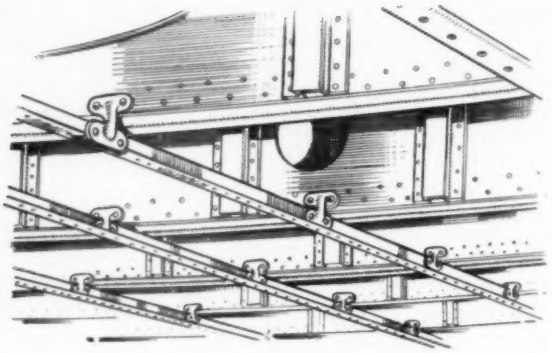
BLUE STREAK.—This was designed as a long-range ballistic missile to deliver a nuclear warhead on targets up to 2,500 n.m. away. Missiles have been built and test launches were due to begin at Woomera this year. In April the project was cancelled as a military missile, but it has not yet been decided whether this large liquid-propellent missile will be used as the basic booster for a British satellite programme.

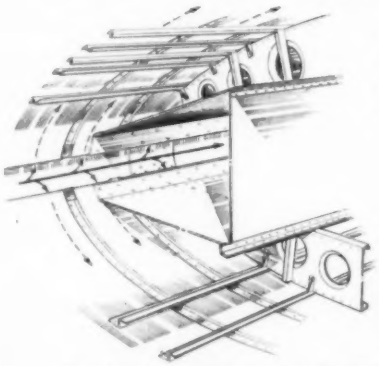
(*Continued on page 296*)



A detail of the centre-section/outer-wing joint fittings.







Attachment of stringers to ribs in the outer-wing structure is by "butterfly" links.

The leading-edge duct for the thermal anti-icing system in the outer wing.

Avro Vulcan B.2

(Four Bristol Siddeley Olympus)

Drawings by B. Hatton. (Jan. 31, 1958).

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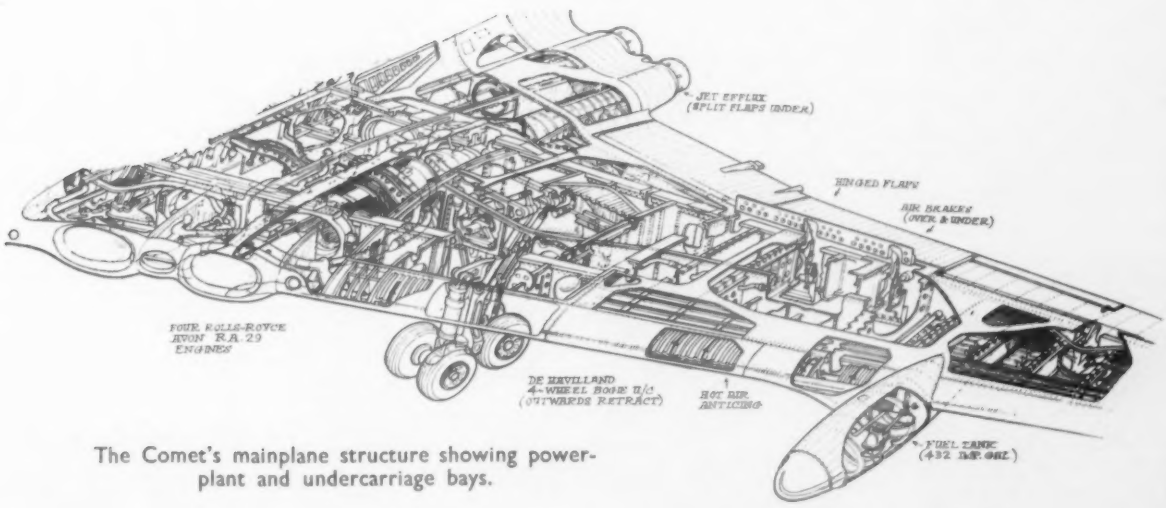
de Havilland Comet 4C

(Four Rolls-Royce Avons)


JET EFFLUX (SPLIT FLAPS UNDER)
HINGED FLAPS
AIR BRAKES (OVER & UNDER)
FOUR ROLLS-ROYCE AVON R.A.29 ENGINES
DE HAVILLAND 4-WHEEL BOGIE U/C (OUTWARDS RETRACT)
HOT AIR ANTI-ICING
FUEL TANK (432 IMP. GAL.)

The Comet's mainplane structure showing power-plant and undercarriage bays.

Drawing by J. H. Clark, A.R.Ae.S. (Oct. 24, 1958).

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Hawker Siddeley Aviation Ltd. . . . .

(*Continued from page 293*)

Folland Aircraft, Ltd.

Hamble, Southampton

NOW a wholly owned subsidiary of Hawker Siddeley, Folland employs 2,150 people and has a total plant area of 430,000 sq. ft. Design and technical offices of the company are at its Hamble works, where two-seat Gnat Trainers are in production for the R.A.F.

The company is also manufacturing aircraft ejector seats and producing major components for the Avro 748 civil transport. Machining work for missiles is being done under sub-contract. Current projects include variants of the Gnat Trainer and the development of a hovercraft in collaboration with Hovercraft Development, Ltd.

GNAT TRAINER.—Development is being concentrated on the two-seat trainer version of the Gnat which is in production for the R.A.F. The earlier single-seat Gnat is being produced in India as an interceptor and has been supplied in evaluation numbers to the Ministry of Aviation, Yugoslavia and Finland. A development batch of 14 Gnat Trainers was ordered initially; production of these is well advanced and a further order for 30 has been given by the Ministry of Aviation. The first flight of a Gnat Trainer was on Aug. 31 last year.

Gloster Aircraft Co., Ltd.

Hucclecote, Gloucester

THIS Hawker Siddeley company employs about 5,000 people at its Hucclecote and Moreton Valence establishments. Its design and production facilities are at Hucclecote and its final-assembly and flight-test establishment at Moreton Valence.

At Hucclecote the production of Javelin FAW.8s is nearly completed. A considerable part of the factory is being taken over by Hawker Siddeley industrial companies and production work is also being handled for the Gloster subsidiary companies which produce agricultural equipment, automatic vending machines, runway sweepers, fire appliances, flat-bed trucks and bulk-liquid conveyors. Production work is also done for the Argosy and Avro 748 transports.

At Hucclecote Javelin FAW.7s are being modified and brought up to Javelin FAW.9 standard. This programme will continue for at least 12 months.

The Gloster aircraft design team is being maintained and expanded. It is helping other aircraft companies of the group with design work and assisting the Hawker Siddeley advanced project group with VTOL and supersonic-transport design.

JAVELIN.—This is the standard two-seat all-weather interceptor of the R.A.F. Production of the FAW.8 has nearly ended; this mark has two Bristol Siddeley Sapphire 7s with reheat. FAW.7s are being modified to FAW.9 standard by the addition of reheat and other changes which include the installation of flight-refuelling equipment.

Hawker Aircraft, Ltd.

Richmond Road, Kingston upon Thames, Surrey

THIS Hawker Siddeley company employs approximately 4,000 people and has a total factory area of nearly 1,200,000 sq. ft. at Kingston, Langley, Richmond Road (Kingston) and Dunsfold aerodrome.

Its headquarters are at Richmond Road, where its research and design staff are housed. Its main factory is also there. Hunter two-seaters and single-seat FGA.9s and FR.10s are in production and single-seat Hunters are also being converted to two-seaters. Its Kingston factory produces components, and Langley is a stores depot. The company's airfield and flight-test establishment is at Dunsfold.

The leading Hawker project is the P.1127 VTOL ground-attack fighter, prototypes of which are being built.

P.1127.—Developed initially as a private venture and later under Ministry of Aviation contract, the P.1127 is designed as a V/STOL ground-attack fighter. It is powered by a single BS.53 lift/thrust ducted-fan engine, and will be the first operational jet-lift VTOL aircraft in the World. Its first flight is expected in October this year.

HUNTER.—In service since 1954 as the R.A.F.'s standard day interceptor, the Hunter is still in production in both its single-seat and two-seat trainer forms. Latest types are the FGA.9 ground-attack version and the FR.10 fighter-reconnaissance version. Export orders for Hunters have earned more money than any other British military aircraft.

A. V. Roe and Co., Ltd.

Greengate, Middleton, Manchester

IN all, approximately 12,000 people are employed by this Hawker Siddeley company, which has in production the Vulcan B.2 strategic bomber, the Avro 748 civil transport and the Blue Steel stand-off bomb. Shackleton maritime reconnaissance aircraft are being converted to T.4 trainers.

Headquarters of the company are at Chadderton, where all aircraft research, design and production work is undertaken. Its airfield, aircraft-assembly and flight-test facilities are at Woodford, where the Avro weapons division also has its design, research, production and engine-test facilities. Blue Steel is in production there.

The weapons division also has a research and development unit at Chertsey, in Surrey, and a design and research group at Kingston upon Thames. The Avro design group at Harrow handles both aircraft and weapon design work. Blue Steels are currently being tested at Woomera; the weapons division has its Australian testing and maintenance base at Edinburgh field.

Other Avro facilities include the Empire works at Failsworth, where metal fabrication work is done; Bracebridge Heath, near Lincoln, where there are mainly stores; and Langar, near Nottingham, where there is an aircraft repair section which has airfield facilities.

Current projects include the Avro 771 twin-jet short-range passenger transport and development of the Avro 748 and Blue Steel.

AVRO 771.—Over the past year or so, the Avro project office has studied several designs for a short-haul jet, and these have now crystallized as the Avro 771. To be powered by two Bristol Siddeley BS.75 turbofans on the rear fuselage, the 771 has a low-mounted swept-back wing and accommodation for about 65 passengers. The optimum design range is about 500 miles.

AVRO 748.—Newest British commercial aircraft to fly, the Avro 748 was undertaken as a private venture in the broad category of a DC-3 replacement. At an early stage in development, the design was adopted by the Indian Air Force, and is to be built at a new factory in Kanpur. Initially, this factory will assemble Avro 748 Series 1s from British components; later, a military version of the Series 2 will be built from Indian materials and will be known as the Avro 757.

Orders for the Series 1, with Dart RDa.6 turboprops, have been placed by Skyways (three) and B.K.S. (two), and delivery of these is scheduled for 1961 after the C. of A. has been obtained next spring. One of the initial production batch of 10 aircraft will be completed as a Series 2 with Dart RDa.7s, and three of this version will be delivered to Aden Airways in 1962. Many other operators are interested in the 748, including the R.A.F.

AVRO 758.—This designation applies to a variant of the Avro 748 having a high wing and rear-loading doors suitable for air-dropping. It has been projected primarily for the Indian Air Force.

BLUE STEEL.—This rocket-powered stand-off bomb has been developed to arm the Mk. 2 Victor and Vulcan strategic bombers. A substantial batch of Blue Steels for trials is being produced; a further order, presumably for operational missiles, will be placed soon. Trials are now being made at Woomera with full-scale test vehicles powered by the de Havilland Double Spectre rocket motor; operational missiles will have the Bristol Siddeley Stentor two-chamber HTP/kerosene rocket motor. Blue Steel is a canard delta-winged missile to carry a nuclear warhead. Development is centred on increasing its range, which is currently estimated at between 100 and 200 miles.

VULCAN B.2.—This advanced version of the Vulcan is in production for R.A.F. Bomber Command. The first was delivered in July this year. It is powered by four 17,000 lb. s.t. Bristol Siddeley Olympus 201s in place of the 13,000 lb. s.t. Olympus 104s of Mk. 1 Vulcans and its span is 12 ft. greater at 111 ft. Vulcan B.2s will carry the Blue Steel stand-off bomb and, in the mid-1960s, Skybolt air-launched ballistic missiles.

Avro Blue Steel stand-off bomb test vehicle under Vulcan 1.

WESTLAND AIRCRAFT, LTD.

Yeovil, Somerset

FOLLOWING incorporation of Saunders-Roe, Ltd., Fairey Aviation, Ltd., and the Bristol helicopter division, this company now forms the third major airframe group in the country. It is devoted almost exclusively to helicopter production and employs a total of 11,000 people.

The company now comprises four divisions. These are known as the Yeovil, Bristol, Fairey and Saunders-Roe divisions respectively. Particulars of the products of each division will be found under the appropriate heading.

Yeovil Division (W.A., Ltd.)

Yeovil, Somerset

THIS division is producing Widgeon, Whirlwind and Wessex helicopters. Development is centred on the Whirlwind 10 and Wessex 2. Work is also proceeding on the Westminster.

WESTMINSTER.—The largest pure helicopter built in Britain, the Westminster is at present the subject of a number of development programmes. Since June, the first prototype has been flying with its fuselage skinned, both prototypes having previously flown with a bare framework. More recently, a Sikorsky six-blade rotor has been fitted to this prototype, and intensive trials are being made in connection with blade stall problems at certain forward speeds. Projected developments of the Westminster design include a passenger transport with 40 seats and a flying-crane with a variety of special mission pods.

WESSEX.—The first large turbine-powered helicopter to go into quantity production in the Western World, the Wessex, in its HAS.1 version, is now entering service with the Royal Navy. Powered by a Napier Gazelle free-turbine engine, it is designed for anti-submarine operations, carrying both detection equipment and offensive armament. A substantial quantity has been ordered. Under development is the Wessex 2, to be powered by two up-rated de Havilland Gnomes. This will carry greater payloads, have a better high-altitude, high-temperature performance and offer engine-out reliability.

Westland Whirlwind civil and military helicopter (one D.H. Gnome).

WHIRLWIND.—Production of the piston-engined Whirlwind is now phasing out in favour of the turbine version with a de Havilland Gnome free-turbine. A substantial number of these was recently ordered, as the Whirlwind 10, by the R.A.F., which will also convert some of its American-powered machines in due course. The Gnome offers a considerable improvement in performance at high altitude and in high temperatures, but the earlier Whirlwind Series 1 (Pratt & Whitney) and Series 2 (Alvis) versions are still available. The Whirlwind HAS.7 is at present standard anti-submarine equipment in the Royal Navy, and two Whirlwind HCC.8s serve with the Queen's Flight.

Westland Saro Sprite multi-purpose helicopter (one Blackburn Nimbus or D.H. Gnome).

WIDGEON.—Derived from the highly successful S.51 and Dragonfly series of helicopters, the Widgeon is available as a new aircraft or a Dragonfly conversion. It seats five and is powered by an Alvis Leonides engine.

Bristol Division (W.A., Ltd.)

Weston-super-Mare, Somerset

FORMERLY the helicopter division of Bristol Aircraft, Ltd., this W.A. division has its research, design and production facilities at Weston-super-Mare, where Belvedere helicopters are in production for the R.A.F. Its major projects are civil variants and derivatives of the Belvedere, the 192C and 192D, and the type 194, which is a larger tandem-rotor helicopter for airline operation.

BELVEDERE.—Westland has assumed responsibility for the production of 30 Belvederes ordered from Bristol by the R.A.F. These are in production at the Weston factory. Several civil versions of the basic design are being discussed with potential operators. These include the 192C, with a fuselage the same size as the Belvedere and a floor channel to increase height down the aisle; the 192D with a new fuselage, wider and higher; and the 194, an altogether larger project, with fixed wing surfaces, powered by four Gnome turbines. B.E.A. said recently that the 194 was among the helicopters in which it was interested.

Fairey Division (W.A., Ltd.)

Hayes, Middlesex

ORIGINALLY Fairey Aviation, Ltd., this Westland division has its design team and factory at Hayes. Its main current work is research and development of the Eland-powered and Tyne-powered versions of the Rotodyne VTOL transport.

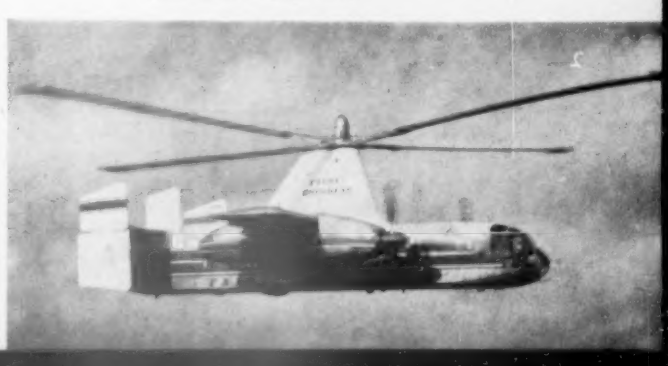
Other activities are development and production of the Gannet anti-submarine and early warning aircraft and the production of precision ferrous castings.

ROTODYNE.—The World's first—and to date only—vertical take-off airliner, the Rotodyne became a Westland project early this year and is now the largest of the company's rotary-wing range. A £4½-million development contract has been placed with Westland by the Government, and both B.E.A. and New York Airways have signified their intention of ordering a developed, Tyne-engined version subject to satisfactory guarantees.

(*Continued on page 299*)

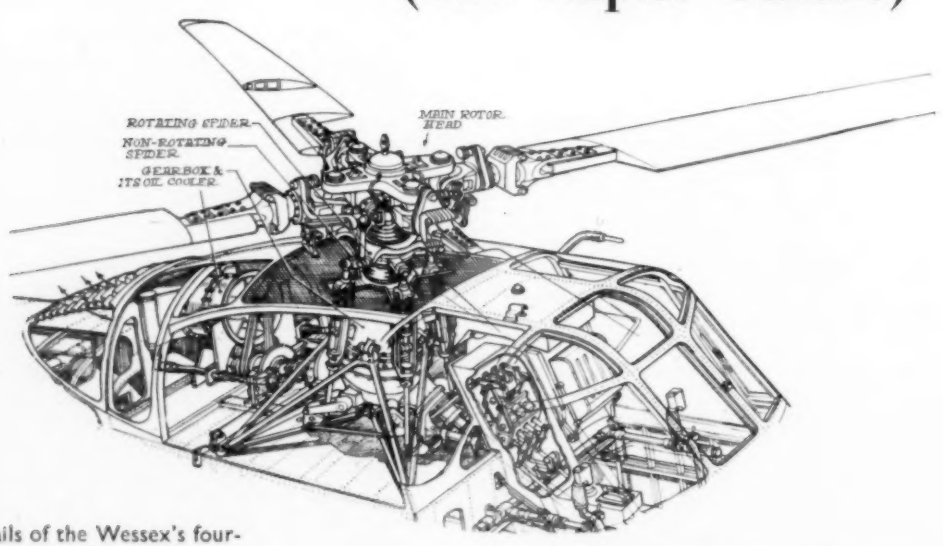
Below, Westland Westminster prototype with faired fuselage (two Napier Elands).

Below right, Westland Fairey Rotodyne VTOL airliner prototype (two Napier Elands).



Westland Wessex H.A.S.1

(One Napier Gazelle)



Details of the Wessex's four-bladed rotor-head and gear-box mounted above the fuselage.

Drawing by J. H. Clark, A.R.Ae.S. (Nov. 29, 1957).

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Westland Aircraft, Ltd. . . . .

(*Continued from page 297*)

GANNET AEW.3.—Westland is completing the existing contract for about 30 of the airborne early warning Gannets for the Royal Navy. This variant went into service earlier this year with No. 849 Squadron.

Saunders-Roe Division (W.A., Ltd.)

Osborne, East Cowes, Isle of Wight

WITH establishments at Cowes and Eastleigh, near Southampton, which is its helicopter development centre, this division of Westlands was formerly Saunders-Roe, Ltd.

At Cowes, Westland is developing the SR-N1 and SR-N2 hovercraft in conjunction with Hovercraft Development, Ltd. Research and development work is also done on the Black Knight re-entry research vehicle, in conjunction with the Royal Aircraft Establishment. Other activities at Cowes include hydrodynamic research and the development of water-borne craft, and the development and production of foil-type strain gauges and electronic accessories.

At Eastleigh, Sprite and Skeeter helicopters are in production, and under development are the Seasprite for the Royal Navy and the Gnome Wasp and Turmo Skeeter helicopters.

SPRITE (WASP).—Versions of the original Saro P.531 private-venture helicopter ordered by the Army and the Royal Navy are to be known as the Sprite and Seasprite. The earlier name of Wasp may be retained for civil machines. A production batch of three Turmo-engined P.531s has already been delivered to the Navy, which is planning to order the Seasprite in large quantities. The first pre-production Sprite for the Army, with Blackburn Nimbus engine, flew on Aug. 4 and the company is also developing a version with a D.H. Gnome turbine, first flown on May 3.

SR-N1.—The first British ground-effect vehicle, the SR-N1 Hovercraft, was developed by Saunders-Roe under contract to Hovercraft Development, Ltd. It was originally powered by a single Alvis Leonides piston engine driving a four-bladed fan to give air-cushion lift and propulsion thrust. A Blackburn Marboré turbojet has now been added to increase propulsion thrust; operating speed has thus gone up to 70 kts.

Westland Bristol Belvedere general purpose helicopter (two Napier Gazelles).

SR-N2.—This advanced hovercraft is being built at Cowes as a joint venture by Westland Aircraft and Hovercraft Development, Ltd. It will be powered by four Blackburn A.129 Nimbus engines, giving a total of 3,750 h.p. It will be designed for a range of operational tasks and will carry up to 68 passengers. The SR-N2 will weigh about 25 tons and its design speed is 70 kts.

BLACK KNIGHT.—Developed by Saunders-Roe in collaboration with the R.A.E., the Black Knight is a re-entry research vehicle associated with the Blue Streak missile programme. Eight successful launches have been made at Woomera.

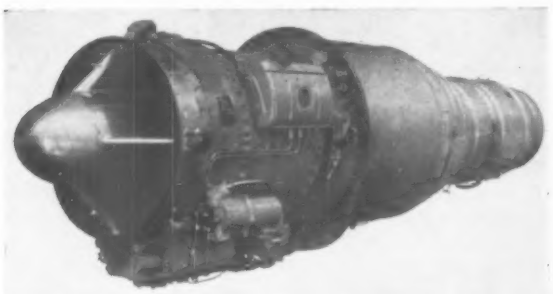
SKEETER.—Production of the Skeeter for the Army Air Corps continues. It was the first helicopter adopted as standard equipment for the A.A.C., and is to be followed in due course by the Sprite. Production models for the Army, and 11 delivered to the German Air Force and German Navy, have Gipsy Major piston engines, but one Skeeter is now flying with a Blackburn Turmo 603, primarily for the evaluation of Elliott helicopter auto-stabilizer equipment.

BRISTOL SIDDELEY ENGINES, LTD.

195 Knightsbridge, London, S.W.7

FORMED in 1958 by the merger of Bristol Aero-Engines and Armstrong Siddeley, the company forms one of the two major aero-engine groups in Britain. It employs 25,000 people. Its activities are divided between its aero division, with headquarters in Bristol, and its power division which is based at Coventry.

At Bristol its factories are at Patchway, Rodney and Whitchurch. At Coventry they are Parkside, Quinton Road, and Ansty. There are other factories at Sunderland and Bentham, Gloucester. The company's head office is in London.



At Patchway the research, design, development and production of aero engines are undertaken. Current types are the Hercules piston engine, Olympus and Orpheus turbojets, Proteus turboprop, Thor ramjet and BS.53 and BS.75 ducted fans. Flight development of engines is based at Filton aerodrome.

At the other Bristol factories, Rodney and Whitchurch, sheet-metal components are produced and engines are repaired and overhauled.

At Parkside, Coventry, Double Mamba turboprops and Viper turbojects are produced, as well as ball screws, ball splines and engine components.

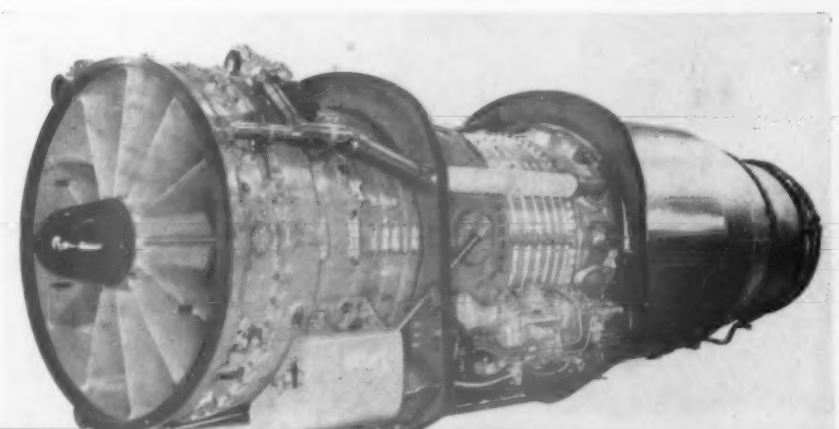
Ansty aerodrome, near Coventry, is where Sapphire turbojets, Maybach diesels and marine and industrial gas turbines are produced. Ansty is also the design, development and production centre for rocket engines.

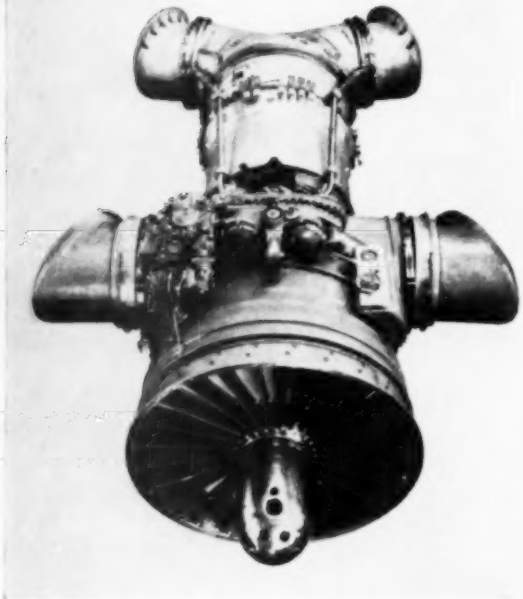
At Quinton Road, Coventry, Cheetah aero-engines are overhauled and repaired. At Sunderland and Bentham, Gloucester, aero-engine components are produced. Orenda turbojets are also repaired and overhauled at Bentham.

Design teams for all aeronautical piston, turbine and

Bristol Siddeley Orpheus Mk. 803 for the Fiat G.91.

Right, Bristol Siddeley Olympus BOe. 21 20,000 lb. thrust turbojet.





Bristol Siddeley BS.53 ducted-fan lift engine.

ramjet engines are at Patchway, Bristol. Liquid-propellent rocket-engine and industrial product design teams are at Ansty, Coventry.

Current activities of the aero division include the further development of existing engines and the development of high by-pass ratio ducted-fan engines for conventional aircraft, VTOL/STOL types and, with reheat, for supersonic projects. The company is devoting special attention to supersonic and hypersonic propulsion systems and to VTOL/STOL powerplants. Bristol Siddeley engines have been specified for a number of new civil projects including VTOL aircraft.

Power division activities include powerplants for hovercraft, for which Maybach diesel engines as well as the Proteus are suitable. Aero engines are also adapted for power generation and marine use.

BS.75.—Few details are available on this ducted-fan engine except its take-off thrust, which is 7,350 lb., and its take-off s.f.c. of 0.5 lb./lb./hr.

BS.53.—This lift/thrust ducted-fan engine will power the Hawker P.1127 VTOL fighter. Four movable jet nozzles allow the front-fan and jet effluxes of the engine to be directed downwards for lift, backwards for thrust or in any intermediate direction. Thrust can also be directed forwards for braking in flight. The BS.53 is a twin-spool engine in which the fan and high-pressure compressor rotate in opposite directions.

BE.58.—Exhibited at Farnborough last year, the BE.58 is a civil ducted-fan engine which is closely related to the BS.53. Take-off thrust is 14,500 lb. at an s.f.c. of 0.572 lb./lb./hr. A low noise level and high thrust-to-weight return of 5.58 : 1 are features of the engine.

STENTOR BSSt.1.—A two-chamber HTP/kerosene rocket engine, the Stentor is in production to power operational versions of the Blue Steel stand-off bomb. Nozzle area of the upper chamber is about four times that of the lower chamber; they are probably fixed- and variable-thrust chambers respectively.

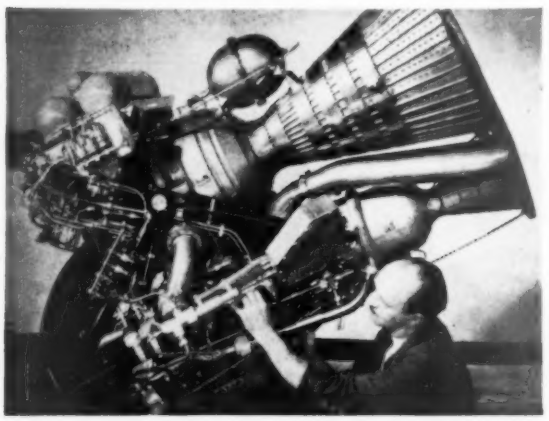
GAMMA 201.—This four-chamber HTP/kerosene rocket engine powers the Saunders-Roe Black Knight re-entry research vehicle. The trunnion-mounted chambers swivel for vehicle flight-path control. Gamma was ordered in 1956 specifically for Black Knight; all eight launches to date have been successful.

BSRJ.824.—This 18-inch-diameter ramjet is designed for operation at high altitude and high supersonic speeds. It is probably developed from the Thor ramjet and may power an advanced version of the Bloodhound SAM. An earlier 18-inch Bristol Siddeley ramjet was the BRJ.801.

THOR.—This 15.75-inch-diameter ramjet is in production as the powerplant for Mk. 1 Bristol/Ferranti Bloodhound SAMs.

ORPHEUS.—The 5,000-lb. thrust Orpheus Mk. 803 is in production for the Fiat G91. Other production versions are the Mk. 100 (4,230 lb.) for R.A.F. Gnat Trainers; the Mk. 701 (4,700 lb.) for Indian and Finnish Gnat fighters; and the Mk. 805 (4,000 lb.) for the Fuji T1F2 trainer. The most advanced Orpheus is the BOr.12, with a thrust of 6,810 lb. which can be boosted to 8,170 lb. by simplified reheat.

OLYMPUS.—Latest version of this high-thrust turbojet is the Olympus 21. Its thrust of 20,000 lb. without reheat is higher than announced for any other current British turbojet. An advanced Olympus with reheat has been specified for the TSR-2. During trials with reheat an Olympus has given a thrust of 33,000 lb. The Olympus Mk. 201 of 17,000-lb. thrust is in production for Avro Vulcan B.2 bombers.



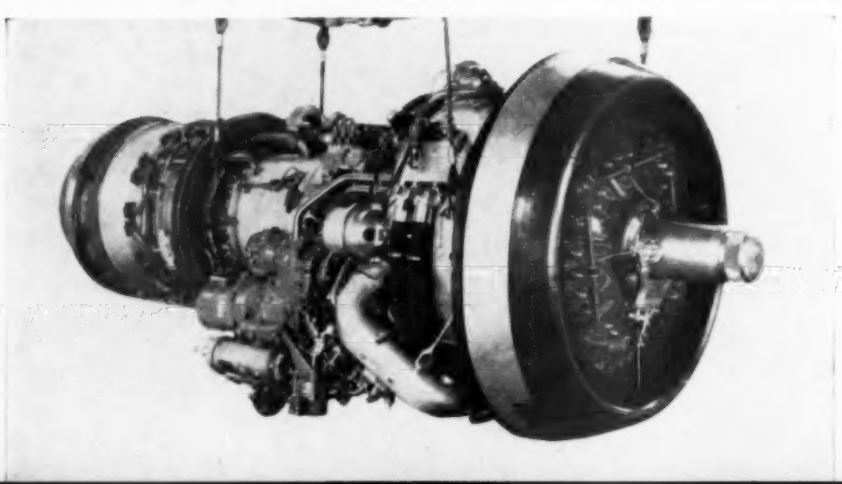
Bristol Siddeley Stentor liquid fuel rocket for Blue Steel.

VIPER.—The Viper ASV.11 of 2,500-lb. thrust powers the Macchi MB325 trainer and the Hunting Jet Provost T Mk. 4. The Mk. 3 Jindivik target drone is also powered by the ASV.11, which gives it a ceiling above 60,000 ft. Later developments are the ASV.12 (2,700-lb. thrust), ASV.20 (3,240-lb. thrust) and the P.201 (3,000-3,830-lb. thrust).

SAPPHIRE.—The last production version of this engine is the ASSa.7R with simplified reheat which powers Javelin FAW.8s and 9s.

PROTEUS 765.—This current production version of the Proteus turboprop powers Britannia civil and military transports. It develops 4,400 e.h.p. for take-off. The Proteus 705 which powers B.O.A.C. Britannia 102s reached an overhaul life of 2,000 hours after 22 months in service; its current overhaul life is 2,400 hours.

DOUBLE MAMBA.—Latest version of this engine is the ASMD.8 of 3,880 e.h.p., which is in production for the Gannet AEW.3.



Rolls-Royce Tyne turboprop for civil and military transports.

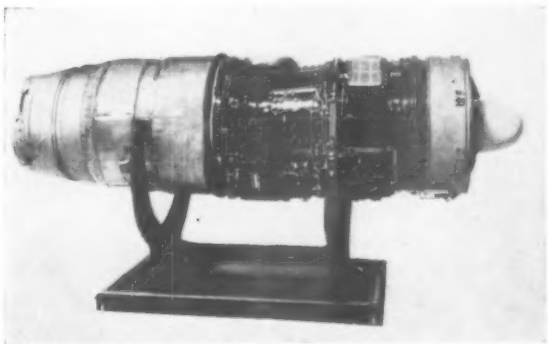
ROLLS-ROYCE, LTD.

Nightingale Road, Derby

A TOTAL of 43,000 people are employed by this world-famous company of whom no fewer than 34,000 are members of its aero-engine division. Although its activities include work on oil engines, nuclear power, cars and fighting vehicles, by far the greater part of its effort is devoted to the development and production of aero engines. Its experience with civil turbine engines is unrivalled.

The company's research, development and engineering establishments are at Derby and Barnoldswick, in Lancashire. Its production factories are at Glasgow and Derby; the production of civil and military engines is shared between these factories. Overhaul facilities for the Conway and Tyne engines are at Derby, and for other engines at Glasgow. The company's flight-test establishment is at Hucknall.

Engines in current production are civil and military versions of the Avon turbojet, civil and military Conway



Rolls-Royce RB.146 Avon 300 series for supersonic fighters.

by-pass engines and versions of the Dart and Tyne turboprops for both civil and military transports.

Under development are new versions of these four engines, the RB.141 and RB.163 second-generation by-pass engines and other projects. These include advanced lightweight engines for jet lift and other by-pass engine designs.

The company has been developing the twin-chamber liquid-propellent rocket engine to power the Blue Streak LRBM. Test runs had been made with this engine, but development has come to a virtual standstill pending a Government decision on the use of Blue Streak for a British space programme.

AVON (Civil).—Developed from the military Avon, the civil RA.29 powers the Comet 4 and the Caravelles 1, 3 and 6. All 90 Caravelles ordered for airline service will have this engine. Its overhaul life was raised to 2,000 hours after less than 20 months in service. Avon-powered airliners have been ordered or put into service by 18 airlines. Latest production version is a developed RA.29/6, which is initially rated at 12,200-lb. thrust, with an increase to 12,725 lb. planned. It has an additional compressor stage and the two-position final nozzle introduced on the RA.29/3 for the Caravelle 3.

AVON (Military).—Various types of military Avon turbojet have been in service for nearly 10 years, during which time the engine thrust has nearly doubled. They have flown 3½ million hours with 17 air forces and have been built under licence in Australia, Belgium and Sweden. Avons power the Lightning, Canberra, Sea Vixen, Hunter, Valiant, Scimitar, Commonwealth Sabre and Saab Draken and Lansen. Latest military Avon is the RB.146 rated at 13,220 lb. without reheat. Both this and its immediate predecessor are supersonic engines with and without reheat. The RB.146 will power the Lightning and Draken; Dassault are offering a version of the Mirage 3 with this engine.

BLUE STREAK ENGINE.—Rolls-Royce have been developing a large double-chamber rocket engine for the Blue Streak LRBM. Based on a Rocketdyne design, it is a kerosene/liquid oxygen engine with a thrust of about 250,000 lb. Test runs have been made at Spadeadam, the rocket test establishment run by Rolls-Royce on behalf of the Ministry of Aviation.

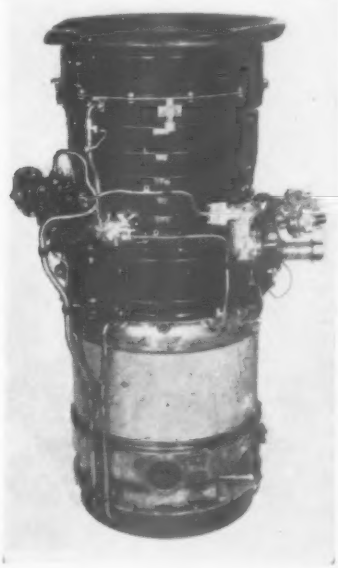
CONWAY.—This is the first by-pass engine to enter service. Military and civil versions are in production for the Handley Page Victor 2 and the Boeing 707-420 and Douglas DC-8/40. The engine is in service with these airliners at a thrust of 17,500 lb. The RCo.42 to power the VC 10 will be rated at 20,250-lb. thrust for take-off; the up-rated RCo.42/2 will give 21,825 lb.

DART.—This was the first turboprop engine to enter airline service, since when civil Darts of all types have flown 12 million hours. Latest airline version is the 3,030-e.h.p. RDa.10 for the Japanese YS-11 airliner. It gives more than double the power of the original Dart with only a 35% weight increase and no change in overall dimensions.

RB.108.—Designed as a jet-lift engine, the RB.108 produces 8.1 lb. of thrust per lb. of weight. Four of these engines form the vertical-lift powerplant of the Short SC.1. The RB.108 is rated at 2,010-lb. thrust plus full air bleed. It has a rapid rate of response to throttle movement. Rolls-Royce are now developing jet-lift engines with half the specific weight of the RB.108; these give 16-lb. thrust for each lb. of engine weight.

RB.141.—Designed for the initial version of the D.H.121 airliner, this by-pass engine was superseded for the D.H.121 application by the RB.163 when the size of the airliner was reduced. The RB.141 first ran in November, 1959. Two versions of the Caravelle are planned with this engine; the first is the Caravelle 8, which will be available for airline service early in 1962.

RB.145.—Derived from the RB.108, this is a lightweight propulsion turbojet of 2,750-lb. thrust. A supersonic military version and a civil version with anti-icing to A.R.B. requirements have been studied.



Rolls-Royce RB.108 lift engine for VTOL aircraft.

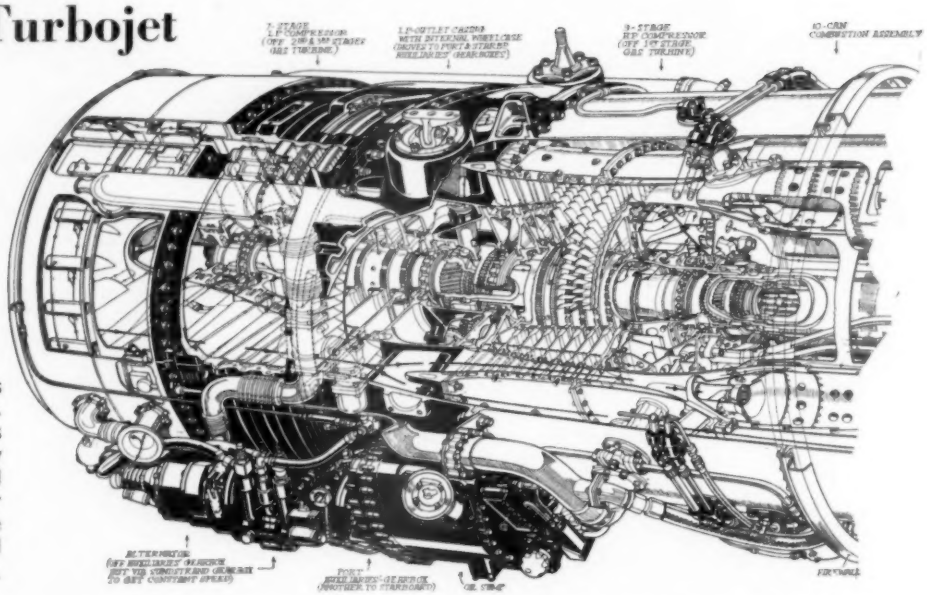
RB.153.—This engine is reported to be the subject of a development and production agreement between the German company M.A.N. Turbomotoren and Rolls-Royce. It is said to be a relatively small high-thrust supersonic turbojet which could be used both as a propulsion and vertical-lift engine. Six RB.153s are reported to be used in the German Entwicklungsring Sud design for a supersonic VTOL strike fighter.

RB.163.—This 9,850-lb-thrust by-pass engine is under development for the D.H.121. It has a by-pass ratio of 1:1 and a pressure ratio of 16 : 1.

TYNE.—Current production versions of this two-spool turboprop are the 4,785-e.h.p. RTy.1 for B.E.A. Vanguards, the 5,325-e.h.p. RTy.11 for T.C.A. Vanguards and the 5,500-e.h.p. RTy.12 for the Canadair CL-44. Development to 10,000 h.p. is expected. Entry into airline service has been delayed approximately six months by a compressor structure fault following unsatisfactory heat treatment. Tynes have been specified for the Rotodyne, Britannic, Breguet Atlantic and Transall C.160. For the Atlantic they may be produced under licence by Hispano-Suiza.

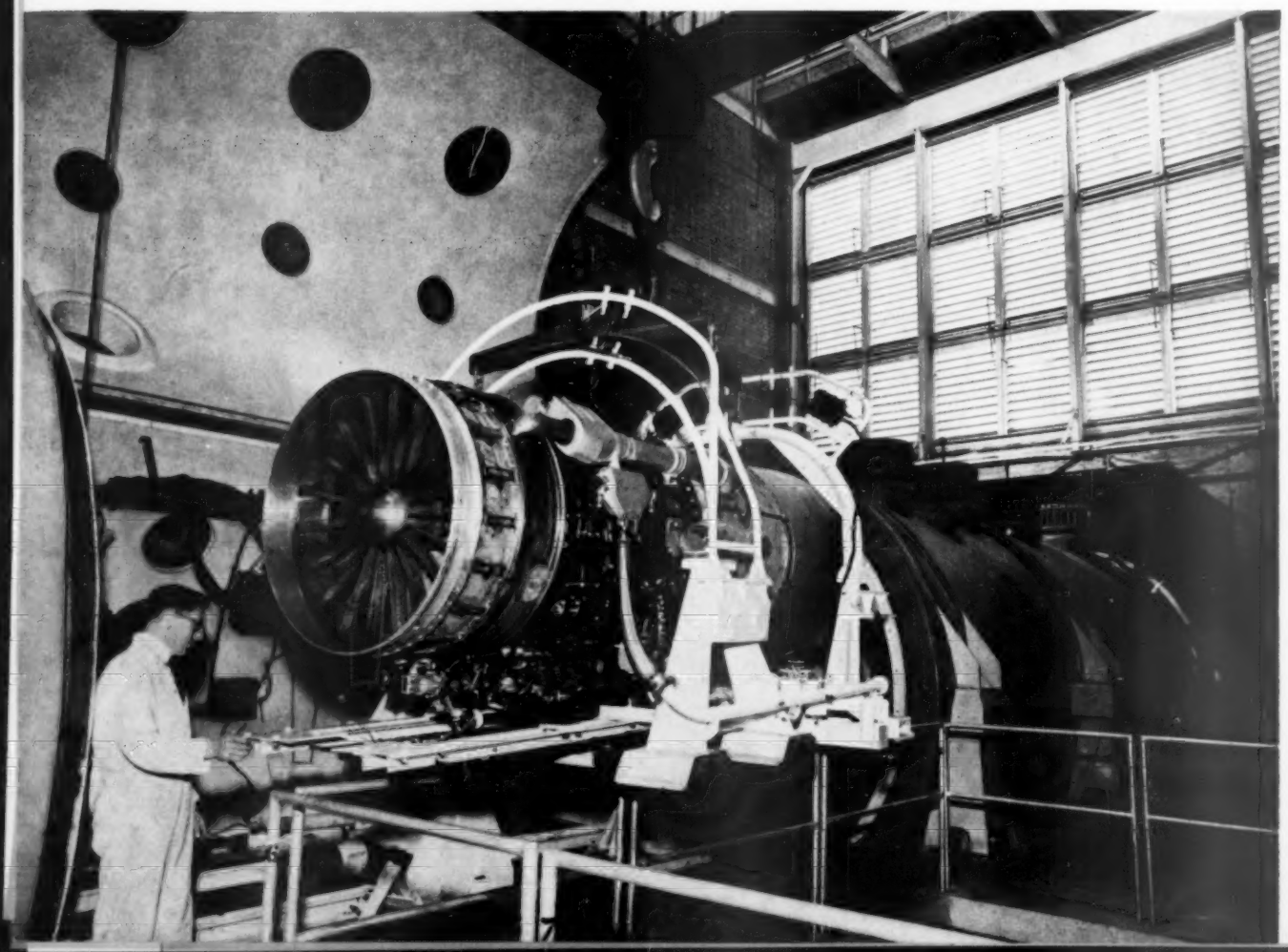
Rolls-Royce Conway

By-pass Turbojet



Details of the Conway's two-spool compressor. These large turbojets are available in military and civil versions and have been chosen for such aircraft as the Victor 2 V-bomber and Vickers VC10 airliner.

Drawing by J. H. Clark, A.R.Ae.S. (Jan. 15, 1960)
Copyright "The Aeroplane and Astronautics."



Outside the Groups

Alvis, Ltd.

Holyhead Road, Coventry

WELL KNOWN for its aero-engine products, this company employs 2,360 people and has a total plant area of 29.02 acres. Total floor area is 567,000 sq. ft. The plant area is made up of the main works, 14.86 acres; assembly plant, 3.32 acres; test-beds, 3.31 acres—3.31 are available for development and service areas.

All design activities are centred at the Holyhead Road factory; the test-beds are at Baginton. On the aero-engine side the company is producing the Leonides and Leonides Major piston engines. New designs being investigated. Much of the Alvis production effort is devoted to manufacturing cross-country vehicles such as the Saracen and Saladin.

LEONIDES.—Production continues of this single-row radial piston engine. Main versions are the 550 h.p. series 514 and the up-rated long-stroke series 531 of 640 s.h.p. Both variants are available as powerplants for helicopters and fixed-wing aircraft.

LEONIDES MAJOR.—This 14-cylinder twin-row radial of 875 h.p. has been developed from the nine-cylinder Leonides. The Mk.155 helicopter version powers Westland Whirlwinds of the Royal Navy and R.A.F. Queen's Flight and Austrian Air Force S.55s.

Auster Aircraft, Ltd.

Rearsby, Leicester

UNIQUE in Britain in having been concerned with the continuous production of light aircraft since 1939, this company has been almost solely responsible for all the light-planes produced in the U.K. since the War. Much of its output at Rearsby has been for the British Army, for which it was until recently the sole supplier of aircraft, and the development of its A.O.P. types has continued alongside that of civil Austers.

A new range of the latter types was introduced in the spring of this year with the appearance of the Auster "D" series, and more advanced designs, with nosewheel undercarriages, are contemplated in the "E" series. Specialized agricultural aircraft are also being produced.

AUSTER "D" SERIES.—Developed through the medium of the Workmaster, the Auster D.4, D.5 and D.6 encompasses a range of some 11 types, with either 32- or 36-ft. wing span, a choice of the 108, 160 or 180 b.h.p. Lycoming engine, and accommodation for two to four passengers. They also differ from earlier Austers in having metal main spars and many other modifications.

AUSTER A.O.P. Mk. 9.—Powered by a 173 b.h.p. Cirrus Bombardier engine, this military Auster has been in production since late 1954 for the British Army and has also been supplied to S. Africa and India. A repeat order was recently received for more Army Air Corps' Mk. 9s.

AUSTER J.1U WORKMASTER.—Intended for agricultural and general utility duties, the Workmaster has a 180 b.h.p. Lycoming O-360-A engine and retains the well-tried rugged steel tube and composite Auster construction. With a 100-gal. spray tank, the Workmaster is a two-seater, but it can carry four on other occasions.

Aviation Traders (Engineering), Ltd.

Southend Airport, Essex

A BRITISH UNITED AIRWAYS company, Aviation Traders (Engineering), undertakes the maintenance and servicing of aircraft of the B.U.A. and Channel Air Bridge fleet, the production of sub-assemblies and ground equipment, and aircraft modifications. A major programme at the moment is the production of the Carvair, a modified DC-4 with nose-loading doors, for use as a vehicle ferry and freighter.

CARVAIR.—From the idea of a "car-via-air," the name Carvair has been derived for the A.T.L.98 conversion of the DC-4. The prototype conversion is now well advanced at Southend and a fleet of Carvairs is to be produced for use by Channel Air Bridge. Modifications include the introduction of a new, lengthened front fuselage with a flight deck above the nose-opening doors; rear fuselage bulkhead repositioned farther aft; rerouted controls; and enlarged fin and rudder. The Carvair is a versatile freighter based on well-proven components and available at low cost around £150,000, including the price of a second-hand DC-4.

Model of Aviation Traders Carvair vehicle ferry conversion of the DC-4.

Photograph copyright "The Aeroplane and Astronautics"

Auster D.4, the two-seat version of the new D range (108 h.p. Lycoming).

Boulton Paul Aircraft, Ltd.

Wolverhampton, Staffs

NOW that this independent company specializes in the production of power-operated controls and electronic research equipment, its aircraft design staff is responsible for development and modifications to military aircraft, a recent example being the design and production-line modification of the Canberra T.Mk.11.

Under M.o.A. contract, an investigation has been made into various types of fans for lifting and controlling VTOL aircraft and experimental fans have been built. A more recent contract covered the investigation of various possible configurations for VTOL aircraft, described below.

Among the configurations investigated by Boulton Paul under this contract is a delta-wing layout with three lifting fans in the wing. A model was tested in the Duplex Tunnel at the N.P.L. Another model built for tests at the R.A.E. Bedford allowed four lift fans to be installed in various ways in a rectangular wing. Another study is for a 96-seat short-haul airliner in which four banks of lift engines are carried at the tips of the wings and a noseplane.

Britten-Norman, Ltd.

Bembridge Airport, Isle of Wight

OPERATING primarily as manufacturers of precision-spraying equipment for agricultural aviation use, this company has developed the Micronair rotary atomizer gear and associated equipment, and specializes in its installation in such aircraft as Tiger Moths and Austers. An overseas agricultural mobility requirement resulted in the design and construction of an air-cushion research vehicle which has now been "flying" successfully for several months.

CUSHIONCRAFT.—This low-cost research vehicle, designed and built in nine months, incorporates several new features. The 40-blade peripheral rotor, which provides the air curtain without lengthy ducting and consequent losses, is driven by direct contact from a conventional car wheel and transmission from a 170 b.h.p. Coventry Climax automotive engine.

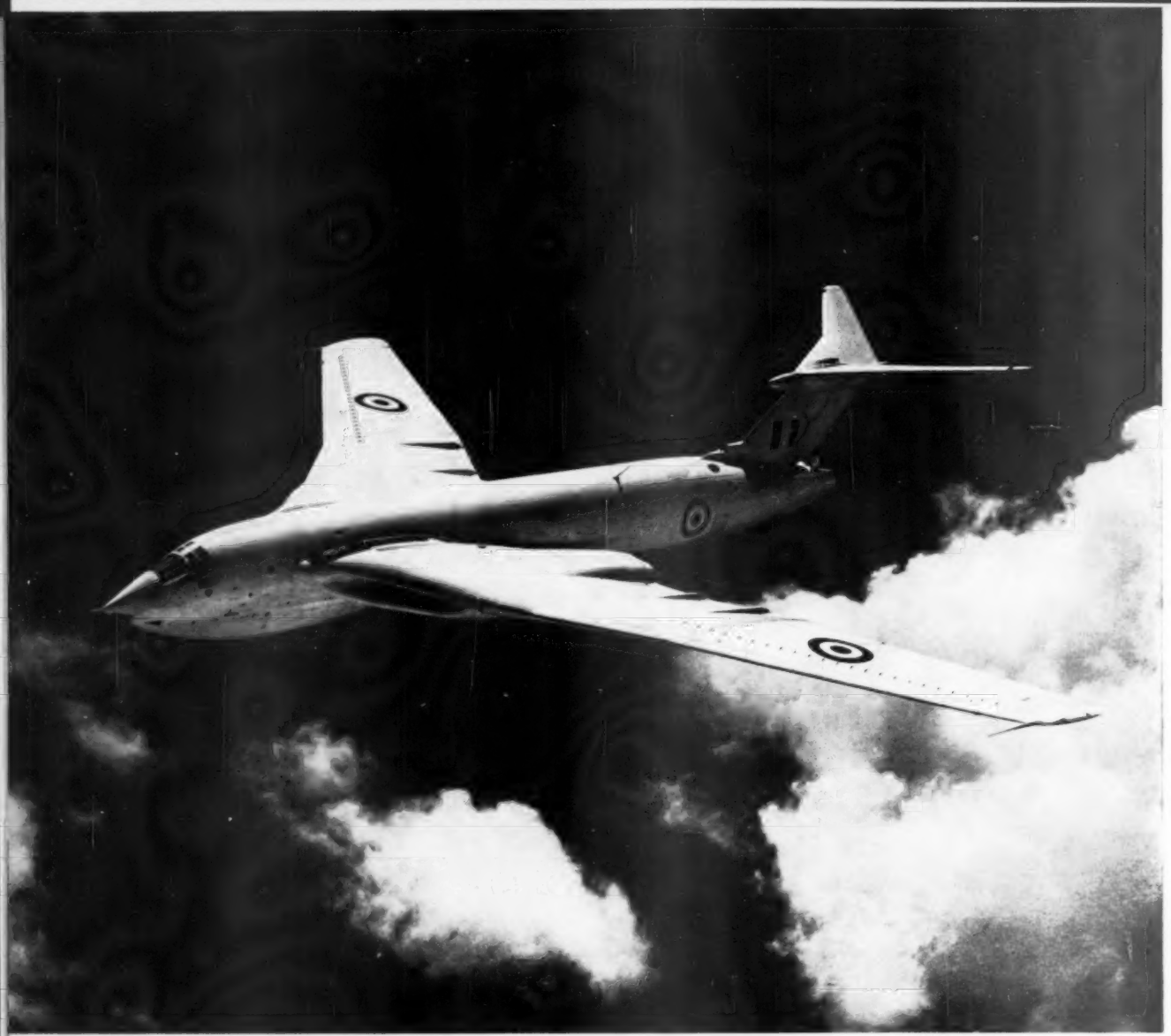
Elliotts of Newbury, Ltd.

Albert Works, Newbury, Berks

HAVING entered the sailplane construction field soon after World War II to develop and produce the well-known Olympia design, this company has since sold some 140 examples of this type, and production of the Olympia 2 is continuing, primarily for club operation.

(*Continued on page* 305)

Right, Britten-Norman Cushioncraft test vehicle for ground effect operation.



Handley Page Victor B.2

(Four Rolls-Royce Conways)

Drawing by Roy Cross. (Dec. 12, 1958).
Copyright "The Aeroplane and Astronautics."

The high-set crescent tailplane is a distinctive feature of the Victor and follows the unusual planform chosen for the mainplane. One tail air-brake is shown open.

(*Continued from page 303*)

Development of the design resulted in the EoN Series 4 sailplanes, with laminar-flow wings, and these have included the 401, 402, 403, 415 and 419. In the last two types, the designations refer to the wing spans, of 15 or 19 metres, for the Standard or Open international classifications.

In an Elliotts 419 sailplane, Cdr. Nick Goodhart was fourth in the recent World Championships. The 419X, with a slightly shorter front fuselage, is continuing in production. Latest EoN development is the 406, which is a 15-m. design with a high aspect-ratio wing and a structure weight some 100 lb. lighter than the Olympia to retain the same wing loading.

The Fairey Company, Ltd.

Woodlands Park, Iver Heath, Bucks

MOST of the former British aircraft interests of Fairey are now owned by Westland following its purchase of Fairey Aviation, Ltd. But the Fairey Company retains all its overseas aviation interests and also a range of aeronautical work in Britain which now comes under Fairey Engineering, Ltd. Headquarters of this company are at Heston in Middlesex.

The Fairey missile/research design and development teams are at Heston. All design work is done here for modifications to the Australian Jindivik target drone and the Malkara anti-tank missile.

The main production factory is at Stockport; at present its only aviation work is the production of main spars and other components for the Gannet AEW.3 under sub-contract to Westland. This factory will also in due course build some parts of the D.H.121 transport under sub-contract. Work on the assembly, conversion, repair, modification and overhaul of Jindiviks will also be done there as from October.

Hydraulic power controls for aircraft form a major Fairey interest in aviation. Between 16,000 and 17,000 units have been built—claimed to be more than by any other company in the World. This activity will now form the hydraulics division of Fairey Engineering, Ltd. It will eventually move to Heston.

JINDIVIK.—Fairey Engineering holds the European sales rights for the Australian-developed Jindivik target drone, which is powered by a Bristol Siddeley Viper turbojet. Under Ministry of Aviation contract the company is responsible for introducing the Jindivik into service in the U.K. and for all modifications, conversions, repairs and maintenance. At present three Jindiviks are being flown at Aberporth.

MALKARA.—Developed in Australia, the Malkara wire-guided anti-tank missile has been ordered for the British Army. Some 400 missiles have been ordered at a cost of approximately £1 million. It will enter service with the Royal Armoured Corps in 1961. Malkara weighs about 200 lb. and is 6 ft. 3½ in. long. It can be mounted on any armoured vehicle. Its range exceeds one mile.

Flight Refuelling, Ltd.

Tarrant Rushton, Nr. Blandford, Dorset

FOUNDED by Sir Alan Cobham to develop and produce equipment for in-flight refuelling, this company has extended its activities to embrace the overhaul and modification of aircraft. In recent years this work has included some specialization in radio-controlled drone conversions for the R.A.F. Two Lincolns were converted to U.Mk.5 drones, but this programme was abandoned and the company has subsequently concentrated on the Gloster Meteor, producing the U.Mk.15 and U.Mk.16 drones.

METEOR U.MK.16.—This latest drone to go into service, is based on the Meteor F.Mk.8 fighter, and incorporates experience obtained with the Meteor U.Mk.15, a drone version of the F.Mk.4. Meteor 15s are operated by Short Brothers and Harland from Llanbedr for the M.o.A. guided weapon firing range at Aberporth, and by the R.A.A.F. at Woomera. The Mk.16 which will succeed it has greater internal fuel capacity for longer endurance, a lengthened nose for the radio-controlled and auto-pilot units, and other special features.

Garland Aircraft, Co., Ltd.

Dale House, Clewer Green, Windsor, Berks

AS Garland-Bianchi Aircraft, this company was formed in 1956 to build under licence the French Piel C.P.301 Emeraude two-seat lightplane. Renamed the Linnet, the first British-built Emeraude made its initial flight on Sept. 1, 1958, from White Waltham, and at the moment remains the sole locally manufactured example of its type in this country. Plans are being made, however, for its large-scale production.

Elliotts new Model 406 15-metre high-performance sailplane.

LINNET.—Powered by the Continental C-90-12F developing 90 b.h.p. for take-off, the Linnet is of all-wooden construction with fabric covering. In its category, it has excellent handling characteristics and cruising performance.

Hampshire Aeroplane Club

Southampton (Eastleigh) Airport, Southampton

ALTHOUGH not established as a manufacturing organization, this club, under the direction of its C.F.I., Vivian Bellamy, has built two Currie Wot single-seat ultra-light biplanes from pre-War designs. The first had a 36-b.h.p. J.A.P. engine, but the second was converted to take a 60-b.h.p. Walter Mikron. It has been experimentally flown with an IS/60 Rover A.P.U. gas-turbine as a turboprop unit.

HILLBOURNE HALCYON.—This four-seat lightplane initially to be powered by two Walter Mikron engines, is being built of wood using new constructional techniques.

Handley Page, Ltd.

Cricklewood, London, N.W.2

ONE of the few major companies to remain independent of the merged groups, Handley Page has its design offices and main factory at Cricklewood. Another factory, final-assembly and flight-test facilities are at Radlett aerodrome. The design factory facilities of its subsidiary, Handley Page (Reading), Ltd., are at Woodley aerodrome, near Reading.

Victor B.2 strategic bombers for the R.A.F. are in production at Cricklewood and Radlett; Victor B.1s are being modified to meet the latest operational needs. Other activities are the overhaul of Hastings transports for the R.A.F. and the full-scale air-tesing of laminarized surfaces. At Reading Herald transports are in production.

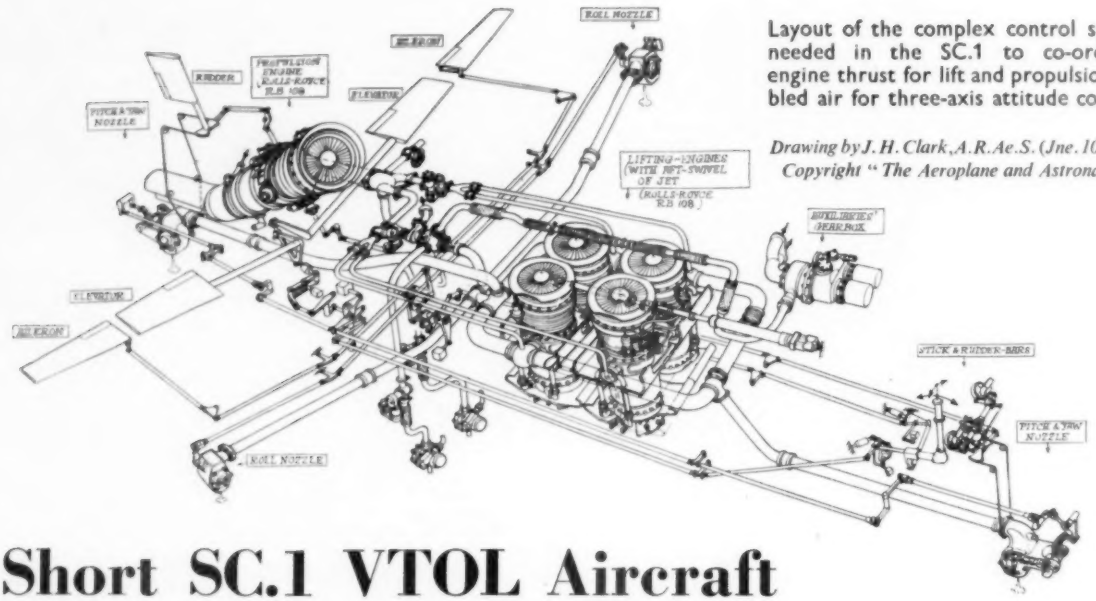
The company is building the H.P.115, a slim-delta research aircraft, under Ministry of Aviation contract. Other projects include design studies of laminar-flow aircraft and of high-subsonic and supersonic military and civil types. A design study is also being made of a short-range passenger, vehicle and heavy-goods transport, the H.P.R.8.

H.P.115.—This single-seat research aircraft is being built to investigate the low-speed behaviour of the slim-delta planforms likely to be used for supersonic airliners. Powered by a single Bristol Siddeley Viper turbojet, it has a slim-delta planform with a very low aspect ratio.

HERALD.—As a result of extensive demonstration tours in the past year using a prototype and the first production Herald, Handley Page has been able to announce the firm interest of several airlines in this feeder-liner. In Brazil, V.A.S.P. has indicated its intention to order seven, possibly in a stretched version of greater all-up weight. B.E.A. expects to operate three Heralds on its Scottish routes next year. For Silver City, the H.P.R.8 vehicle ferry and air-bus has been projected, using Herald wings and other components with a new fuselage.

(*Continued on page 307*)

Handley Page Herald feeder-liner in B.E.A. colours (two Rolls-Royce Darts).



Layout of the complex control system needed in the SC.1 to co-ordinate engine thrust for lift and propulsion and bled air for three-axis attitude control.

Drawing by J. H. Clark, A.R.Ae.S. (Jne. 10, 1960)
Copyright "The Aeroplane and Astronautics"

Short SC.1 VTOL Aircraft

(Five Rolls-Royce RB.108s)

(*Continued from page 305*)

VICTOR B.2.—In production for the R.A.F. Bomber Command, this advanced version of the Victor is powered by four Rolls-Royce Conway by-pass engines. Victor B.2s will carry the Blue Steel stand-off bomb. The order for these bombers was reduced early in August following a consideration of future defence needs. Present plans call only for Vulcan B.2s to carry Skybolt air-launched ballistic missiles, but Handley Page claim that without modification the Victor 2 could carry these missiles.

Photograph copyright "The Aeroplane and Astronautics"

Lancashire Prospector utility and agricultural aircraft (295 h.p. Lycoming).

Lancashire Aircraft Company.

Samlesbury Airfield, nr. Blackburn, Lancs

AS a wholly-owned subsidiary of Samlesbury Engineering, Ltd., this company procured the design, development and manufacturing rights of the E.P.9 utility aircraft from Edgar Percival Aircraft, Ltd., in October, 1958. Production is centred on Samlesbury, with final assembly and test flying at Squire's Gate. Subsequent development of the Prospector has been mainly concerned with increasing the power margin for agricultural and similar duties, and the original 270 b.h.p. Lycoming was replaced in production by the 295 b.h.p. unit from the same manufacturer. In recent weeks, a 410 b.h.p. Cheetah X radial engine has been experimentally fitted to the Prospector II.

PROSPECTOR.—About 25 of these aircraft have so far been sold, mainly to agricultural operators in this country, Australia and elsewhere, and the type has shown great versatility. Accommodation is for pilot and five passengers, or equivalent freight; alternatively a 170 Imp. gal. (33 cu. ft.) chemical hopper may be fitted in the cabin.

Marshalls' Flying School, Ltd.

Cambridge Airport, Cambs

THIS company specializes in the overhaul and modification of aircraft under contract to the manufacturers, airlines, the M.o.A. and the fighting Services. A recent task has been the design, construction and testing of a small boundary-layer control research aircraft.

M.A.4.—This research aircraft, based on an Auster A.O.P., has been built under M.o.A. contract for use in a Cambridge University research programme into boundary-layer control by suction. Suction through perforated surfaces of the aircraft is used to obtain high lift.

F. G. Miles, Ltd.

Shoreham Airport, Sussex

WITH one of the best-known names in British Aviation, the Miles family re-entered the aircraft construction field in 1951, and with subsidiary companies for the development of plastics, precision mechanical components and electronic equipment, is continuing an active programme. Recent aircraft activity has been concentrated on the M.100 Student light jet trainer and communications type, which first flew in May, 1957, but no production orders for this have yet been announced.

M.100 STUDENT.—Powered by an 880-lb. Blackburn-Turboméca Marboré IIA turbojet, the Student is intended as a low-cost and economical *ab initio* jet trainer, and for many other rôles such as reconnaissance and ground support duties. Basically seating two side-by-side, it may carry four with slight modification.

D. Napier and Son, Ltd.

Acton, London, W.3

THIS direct subsidiary of the English Electric Co., Ltd., has not been concerned in the formation of the British Aircraft Corporation.

The company's headquarters and design offices are at Acton and its production factory is at Liverpool. It has test-beds at Park Royal and at its Luton flight-development establishment.

Eland and Gazelle engines are in production. Other major activities of the company include development and production of Spraymat electrical de-icing systems for aircraft and engines; this technique is now being developed for helicopter rotor-blade de-icing. Napiercast precision castings are produced for a range of applications. The company has also developed its Scorpion series of liquid propellent rocket engines and HTP tip-drive systems to boost helicopter performance.

GAZELLE.—The NGa.2 and NGa.13 versions of this 1,650-s.h.p. free-turbine powerplant for helicopters are in production for the Belvedere and Wessex respectively. The latest Gazelle is the 512 variant in which the power drive is taken direct from the free-turbine shaft.

ELAND.—This single-shaft turboprop is in production for Canadair CL-66 transports for the R.C.A.F. and Canadair 540s for Allegheny Airlines. These aircraft have the Eland 504A. Other variants of the engine power the prototype Rotodyne and Westminster helicopters.

Pye, Ltd.

Cambridge

THIS radio company is developing an anti-tank missile, the Python, as a private venture at the company's Royston establishment. The major activities of Pye are in aerial communications and ILS systems, telecommunications equipment, scientific instruments and transmission equipment.

PYTHON.—This private-venture wire-guided anti-tank missile is in advanced state of development. Powered by a two-stage solid-propellent motor, it is controlled by jet deflection. Only the control mechanism is roll stabilized, and not the entire missile.

Rollason Aircraft and Engines, Ltd.

Croydon Airport, Croydon, Surrey

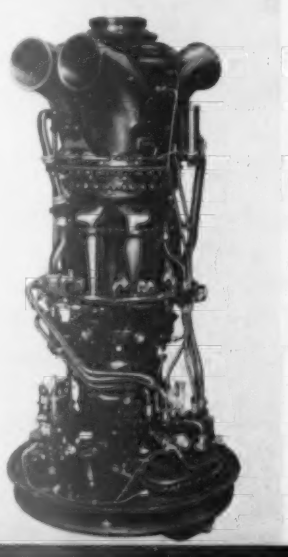
LONG established as an aircraft repair, overhaul and sales organization, this company began manufacturing in 1957 with the acquisition of the licence for the Druine Turbulent ultra-light single-seater. Rollasons also specialize in the overhaul and reconstruction of D.H. Tiger Moths to virtually new standards and have modified several of these aircraft as advanced aerobatic machines with inverted fuel and oil systems. The company are also U.K. agents for the French S.A.N. Jodel organization of Bernay, which produces the D.R.100 Ambassadeur and the D.140 Mousquetaire.

TURBULENT.—Of wooden construction, this little single-seater is powered by a 30 b.h.p. Ardem flat-four engine, and in the Rollason version is being produced with a coupé sliding hood, spats and other refinements. In one of these aircraft, Sqn. Ldr. John Severne recently won the King's Cup and British Air Racing Championship at a speed of 105¼ m.p.h.

Scottish Aviation, Ltd.

Prestwick Airport, Ayrshire

FORMED in 1935 as an aviation centre for Scotland, for the repair, overhaul and modification of all types of aircraft, and for the development of Prestwick Airport, Scottish Aviation entered the manufacturing field in 1950 with the introduction of the Pioneer STOL machine. More than 50 single-engined Pioneers were subsequently produced, and development is now concentrated on the considerably larger Twin Pioneer, which retains similar very short take-off and landing characteristics. The 16-passenger Twin Pioneer is available for both civil and military use, production now being



Napier Gazelle free-turbine helicopter engine for the Belvedere and Wessex.

Scottish Aviation Twin Pioneer in military guise (two Alvis Leonides).

concentrated on the Series 3 aircraft, with more powerful engines.

TWIN PIONEER SRS. 3.—In addition to about 30 civil Series 1s, 32 Twin Pioneer C.C. Mk. 1 and four C.C. Mk. 2 aircraft were delivered to the R.A.F., these being basically equivalent to the Series 1 type, which are powered by Alvis Leonides 128 (514/8A) engines. The Series 3 Twin Pioneer has Leonides 138 (531/8B) powerplants, which develop 600/625 b.h.p. for take-off instead of 540/560 b.h.p., and greatly improve the single-engine performance. Three military Twin Pioneer Series 3 are now being assembled for the R.A.F.

Short Brothers and Harland, Ltd.

Queens Island, Belfast

ABOUT 7,000 people are employed by this company, which has factories in Northern Ireland with a floor area totalling some two million sq. ft. Aircraft design and production facilities are at its Queens Island factory, where the production of military Britannias is nearing completion. Also in production there is a reconnaissance version of the English Electric Canberra, the PR.9, and the U.10 drone conversion of the Canberra which is used as a target aircraft for missile trials.

Short SC.7 Skyvan light general purpose transport (two Continentals).

Short Seacat ship-to-air missiles in quadruple launcher.

Two new types of Short design are also under construction at Queens Island; they are the Britannic military freighter, which is being developed for the R.A.F., and the Skyvan light civil freighter which the company is producing as a private venture. First flight of the Skyvan is expected next year. The Britannic is scheduled to make its maiden flight in April, 1962.

The Short precision engineering division at Castlereagh is responsible for the design, development and production of computers and hydraulic and electronic equipment. The Seacat short-range surface-to-air missile is also developed there, but quantity production will be at Queens Island.

The company also has two factories at Newtownards; one has a heavy machine shop largely devoted to aircraft work and the other is devoted to general engineering; its products include aircraft seats and domestic appliances.

Apart from the Britannic and Skyvan, Short projects include studies of high-speed VTOL aircraft using the jet-lift principle proved with the Short SC.1 research aircraft. The company has a Ministry of Aviation research contract for the further development of the VTOL idea.

SKYVAN.—First product of Short's Light Aircraft Division, the SC.7 Skyvan is a private venture freighter, expected to fly next summer. Two prototypes are being built at Belfast. The Continental engines are probably to be built by Rolls-Royce. With rear-loading facilities, the SC.7 can carry a car of up to 3,000 lb. weight, 15 passengers or paratroops, 12 stretchers, 3,000 lb. of dust or liquid insecticide, or a variety of freight loads.

BRITANNIC.—Production of a dozen or so Britannics will be required for the R.A.F. under a contract soon to be completed. Work on the prototype, to fly in April, 1962, has already begun, with delivery of the production aircraft scheduled for 1964. The Britannic is the largest turboprop aircraft in this country, and is to be developed as a civil freighter in parallel with the military version.

Short Britannic freighter for R.A.F. Transport Command (four R.-R. Tynes).

SC.1.—Powered by five Rolls-Royce RB.108 engines, the SC.1 is Britain's first flat-rising jet-lift aircraft. One RB.108 is used as a propulsion engine, the other four discharge vertically downwards to give jet lift. The first of the two SC.1s built flew as a conventional aircraft on Apr. 2, 1957. The first untethered vertical take-off was on Oct. 25, 1958, and the first transition from wingborne conventional flight to jet-lift hovering and back was on Apr. 6, 1960.

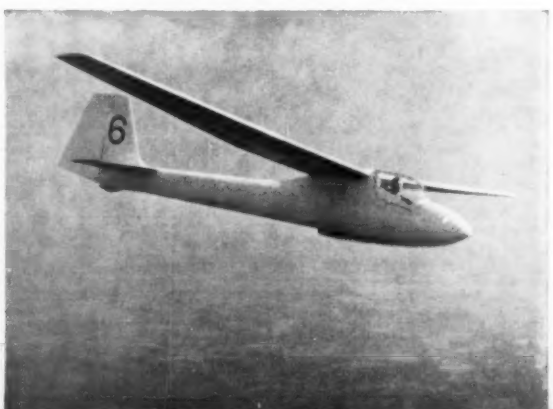
SEACAT.—This short-range anti-aircraft missile has been under development for the Royal Navy since 1958. The New Zealand and Australian navies intend to adopt the missile and it is also to be evaluated by Sweden and Germany. Focke-Wulf may undertake joint development of the missile if it is ordered by Germany. A relatively small short-range missile, the Seacat is believed to have a two-stage solid-propellent motor and radio command guidance. A land-based version of the missile, the Tigercat, has been mentioned as a Short private venture.

Slingsby Sailplanes, Ltd.

Kirbymoorside, Yorkshire

SINCE gaining his "C" certificate on his own Falcon I in 1931, Mr. F. N. Slingsby has supplied more sailplanes than almost any other manufacturer throughout the World. His unrivalled contribution to the British gliding movement has been further enhanced by the formation of the Shaw-Slingsby Trust, Ltd., which owns the entire share capital of the company and puts the distributed profits to work for the movement as a whole.

Current production sailplanes include the moderately priced high performance Type 45 Swallow; the Type 42 Eagle 3 two-seater; the 15 m. Type 41 Skylark 2B; the 18 m. Type 43 Skylark 3B and the new Skylark 3F; and the Type 21B Sedbergh two-seater trainer. In one of the six Skylark 3s entered for the recent World Gliding championships, Hossinger of the Argentine became the overall winner.



Slingsby Skylark IIIF flown by Col. A. J. Deane-Drummond.

British Aircraft Industry Data Sheets

Commercial Transport Aeroplanes

AIRCRAFT	POWER PLANT				ACCOMMODATION									DIMENSIONS				LOADINGS		
	No.	Type	T.-o. power (each)		Normal first class	Typ. mixed class	Max. coach	Internal cabin*					Total freight hold volume†	Span	Length o.a.	Height o.a.	Gross wing area	Wing loading (t.-o. wt.)	Wing loading (land. wt.)	Power loading
								Length	Max. height	Max. width	Floor area	Usable volume								
			lb.s.t. e.h.p. or b.h.p.	r.p.m.				ft. in.	in.	in.	sq. ft.	cu. ft.	cu. ft.	ft. in.	ft. in.	ft. in.	sq. ft.	lb./sq. ft.	lb./sq. ft.	lb./lb.s.t. lb./e.h.p. or lb./b.h.p.
Argosy	4	Dart 526 (RDa.7)	2,100	15,000	—	—	83	46 8	80	120	426	3,680	Nil	115 0	86 9	27 0	1,458	60.0	55.5	10.5
Avro 748/1	2	Dart 514 (RDa.6)	1,600	14,500	40	—	44	46 6	76	96.5	296	1,990	Nil	95 0	67 0	24 10	795	41.5	41.5	9.48
Avro 748/2	2	Dart 531 (RDa.7)	1,910	15,000	40	—	44	46 6	76	96.5	296	1,990	Nil	95 0	67 0	24 10	795	45.25	44.65	8.55
BAC H-107	2	BS-75	7,350	—	—	50	59	48 8	74.5	120	—	—	—	81 8	84 11	23 0	825	58.8	55.7	3.3
Caribou	2	P. & W. R-2000-7M2	1,450	2,700	—	—	32	28 9	75	87	175	1,150	Nil	96 0	72 7	31 9	912	28.5	28.5	8.97
Carvair (ATL 98)	4	P. & W. R-2000-7M2	1,450	2,700	—	—	85	80 2	81	118.5	665	4,350	151	117 6	102 7	30 0	1,462	50.5	43.9	12.7
Comet 4	4	Avon 525B	10,500	8,050	60	67	81	71 9	79	116	439	2,815	570	114 10	111 6	29 6	2,121	76.4	56.6	3.86
Comet 4B	4	Avon 525B	10,500	8,050	72	88	101	78 3	79	116	529	3,160	640	107 10	118 0	29 6	2,059	76.7	58.2	3.76
Comet 4C	4	Avon 525B	10,500	8,050	72	88	101	78 3	79	116	529	3,160	640	114 10	118 0	29 6	2,121	76.4	56.6	3.86
Herald	2	Dart 527 (RDa.7/2)	1,910	15,000	38	42	48	48 9	77	104	260	2,193	Nil	94 4½	71 11	24 0	886	43.9	43.3	9.3
Heron 2	4	Gipsy Queen 30 Mk. 2	250	2,500	14	—	17	23 0	69	54	89	515	127	71 6	48 6	15 7	499	27.1	26.4	13.5
Rotodyne	2	Tyne	5,259	—	—	57	75	47 9	84	115	425	3,000	Nil	56 6‡	66 1	26 0	584‡	91.6‡	91.6‡	5.1
Trident	3	RB 163-1	10,100	12,410	—	79	100	66 10½	80	136.5	708	4,440	620	89 10	114 9	27 0	1,358	77.8	74.1	3.46
Twin Pioneer 3	2	Leonides 531/8B	625	3,200	—	16	19	22 8	69	72	129	730	96	76 6	45 3	18 0	670	21.8	21.8	11.4
Vanguard II	4	Tyne 512 (RTy.11)	5,545	15,200	76	97	139	90 0	82.5	128.8	893	5,690	1,360	118 0	122 10½	34 11	1,529	96.0	88.3	6.6
VC10	4	Conway 540	20,250	9,955	88	114	150	91 4	90	138	—	—	1,350	140 0	158 10	39 1½	2,800	106.9	70.5	3.7
Super VC10	4	Conway RCo.42/2	21,825	9,955	—	150	212	118 6	90	138	—	—	—	146 0	186 0	39 6	2,800	123.9	86.0	3.9
Viscount 810	4	Dart 525 (RDa.7)	1,990	15,000	52	53	73	54 0	78	117	520	2,680	370	93 8½	85 8	26 9	963	75.4	64.4	9.11

* Internal cabin dimensions exclude the flight deck. † Freight volumes exclude capacity within the main cabin. ‡ Rotor diameter is 104 ft., area 8,490 sq. ft., disc loading 6.3 lb./sq. ft.

AIRCRAFT	WEIGHTS						PERFORMANCE										
	Basic Op.	Total fuel	Mfrs. max. payload	Max. take-off	Max. landing	Max. zero fuel	Typical Cruise			App-roach speed	Take-off Field length required			Landing distance from 50 ft.	Range (take-off to landing) no reserves				
							Speed	Alt.	Wt.		I.S.A. s.l.	I.S.A. + 15°C. s.l.	I.S.A. 5,000 ft.		With max. fuel				With max. payload
															Range	Payload	Speed	Alt.	
	lb.	lb.	lb.	lb.	lb.	lb.	knots	ft.	lb.	knots	ft.	ft.	ft.	ft.	n. mi.	lb.	knots	ft.	lb.
Argosy	48,000	26,000	28,000	88,000	80,000	76,000	245	18,000	70,000	109	4,900	5,300	6,400	3,100	2,300	13,600	226	20,000	800
Avro 748/1	19,444	3,890	9,666	33,000	33,000	29,110	230	20,000	31,000	92	3,500	3,750	4,750	2,190	1,650	4,436	234	20,000	580
Avro 748/2	20,244	5,990	9,666	36,000	35,500	30,010	252	25,000	34,000	94	3,510	3,780	4,630	2,325	1,830	6,581	257	25,000	1,050
BAC H-107	29,000	17,840	12,000	48,500	46,000	41,000	400	32,000	44,000	110	4,700	—	—	2,800	2,500	—	—	—	950
Caribou	17,350	4,860	7,550	26,000	26,000	26,000	158	7,500	26,000	72	1,645	—	—	1,020	1,100	3,000	158	7,500	—
Carvair (ATL 98)	41,365	14,800	17,635	73,800	64,170	59,000	180	10,000	65,000	93	5,300	5,950	7,050	2,800	3,000	10,000	177	10,000	2,000
Comet 4	75,150	71,260	20,300	162,000	120,000	99,000	410	35,000	140,000	124	6,600	7,400	9,200	6,000*	3,750	15,600	—	—	3,410
Comet 4B	78,600	60,400	23,900	158,000	120,000	102,500	415	34,000	140,000	128	6,650	7,450	9,300	5,950	2,972	—	—	—	2,652
Comet 4C	79,600	71,260	22,900	162,000	120,000	102,500	410	35,000	140,000	126	6,600	7,400	9,200	6,000*	3,720	11,150	—	—	2,910
Herald	24,220	8,750	11,780	39,000	38,500	36,000	238	20,000	36,000	90	4,150	4,700	5,700	2,120	1,500	6,140	266	23,000	750
Heron 2	8,961	2,965	4,539	13,500	13,150	12,740	159	8,000	12,500	81	3,560	3,870	5,150	2,065	1,350	1,320	159	8,000	365
Rotodyne	35,564	10,000	16,000	53,500	53,500	—	175	5,000	53,500	—	—	—	—	—	640	8,000	175	5,000	75
Trident	63,130	30,720	22,370	105,000	100,000	85,500	509	32,000	All	134	6,000	6,700	8,250	3,760	2,290	11,750	459	35,000	1,330
Twin Pioneer 3	10,062	1,780	4,000	14,600	14,600	—	122	8,000	14,600	70	1,150†	—	—	1,150	662	2,500	114	5,000	100
Vanguard II	85,500	41,040	37,000	146,500	130,500	122,500	358	20,000	135,000	131.5	6,550	7,950	9,000	6,400*	2,720	20,500	356	25,000	1,590
VC10	138,500	138,000	38,000	299,000	197,500	176,500	480	47,000	240,000	122.5	7,400	8,650	9,500	6,400*	5,600	24,500	460	42,000	4,800
Super VC10	161,000	150,000	58,000	347,000	241,000	219,000	470	38,000	250,000	—	10,400	—	—	4,670	5,180	36,000	—	—	4,230
Viscount 810	43,000	15,200	14,500	72,500	62,000	57,500	309	18,000	60,000	119	5,990	6,480	7,950	4,270*	1,530	14,300	290	24,000	1,500

* Landing field length required. † Take-off to 50 ft.

British Aircraft Industry Data Sheets . . .

Offensive Military Aeroplanes

AIRCRAFT	POWERPLANT No.	POWERPLANT Type	POWERPLANT T.-o. power (each)	DIMENSIONS Span	DIMENSIONS Length o.a.	DIMENSIONS Height o.a.	DIMENSIONS Gross wing area	Crew	ARMAMENT AND EXTERNAL STORES
			lb. s.t.	ft. in.	ft. in.	ft. in.	sq. ft.		
Blackburn NA.39	2	Gyron Junior 101 (D.Gy.2)	7,100	42 6	62 4	16 0	—	2	Bombs (including tactical nuclear) in internal weapons bay with rotary door.
Canberra B.2	2	Avon 1 (RA.3)	6,500	64 0	65 6	15 7	960	3	6,000 lb. internal bombs; 2×244 I.G. tip tanks.
Canberra PR.3	2	Avon 1 (RA.3)	6,500	64 0	66 8	15 7	960	2	7 cameras; photoflashes 1,851 lb.; 2×250 I.G. tip tanks.
Canberra B.6	2	Avon 109 (RA.7)	7,400	64 0	65 6	15 7	960	3	2×4,000 lb. H.C. bombs (max. load); 2×250 I.G. tip tanks.
Canberra PR.7	2	Avon 109 (RA.7)	7,400	64 0	66 8	15 7	960	3	1 F.49 and 6 F.52 cameras (day); 2 F.49 cameras and 2 photo cells and 1,950 lb. photoflashes (night). Tip tanks.
Canberra B(I).8	2	Avon 109 (RA.7)	7,400	64 0	65 6	15 7	960	2	4×20 mm. Hispano; 2×1,000 lb. bombs or 16× recce. flares internal; 2×1,000 lb. bombs external.
Canberra PR.9	2	Avon 206	—	68 0	66 8	15 7	—	2	Unarmed. Cameras and photoflashes. Tip tanks.
Gannet AEW.3	1	Double Mamba 102	3,875	54 6	44 0	—	490	3	Unarmed for airborne early-warning rôle.
Gannet AS.4	1	Double Mamba 101	3,035	54 4	42 11	13 9	480	3	Internal bombs, mines, depth charges, etc.; external rockets, depth charges, sonobuoys, etc.
Gnat F.1	1	Orpheus 701	4,520	22 2	29 9	8 10	137	1	2×30 mm. Aden (115 r.p.g.); 2×500 lb. bombs or 18×3 in. rockets or 2×66 I.G. tanks.
Hunter F.6/FGA.9	1	Avon 203/207 (RA.28)	10,000	33 8	45 10½	13 2	349	1	4×30 mm. Aden (150 r.p.g.); 2×1,000 lb. and 2×500 lb. bombs or R.P. pods or 2×230 and 2×100 I.G. tanks.
Hunter FR.10	1	Avon 203/207 (RA.28)	10,000	33 8	46 1½	13 2	349	1	4×30 mm. Aden (150 r.p.g.); 2×230 I.G. and 2×100 I.G. tanks.
Javelin FAW.1/4/5	2	Sapphire 102/103 (ASSa.6)	8,300	52 0	56 4	16 0	928	2	4×30 mm. Aden; 2×250 I.G. ventral tanks.
Javelin FAW.2/6	2	Sapphire 102/103 (ASSa.6)	8,300	52 0	56 4	16 0	928	2	4×30 mm. Aden; 2×250 I.G. ventral tanks.
Javelin FAW.8	2	Sapphire 203/204 (ASSa.7R)	12,300	52 0	56 4	16 0	928	2	2×30 mm. Aden; 4×Firestreak AAM; 2×250 I.G. ventral tanks.
Javelin FAW.9	2	Sapphire 203/204 (ASSa.7R)	12,300	52 0	56 4	16 0	928	2	2×30 mm. Aden; 4×Firestreak AAM; 2×250 I.G. ventral tanks.
Lightning F.1	2	Avon 200 (RA.24R)	14,430	34 10	50 0	19 7	—	1	2 or 4×30 mm. Aden; 2×Firestreak AAM or 48×2 in. R.P.
Sea Hawk FGA.6	1	Nene 103	5,400	39 0	39 8	8 9	278	1	4×20 mm. Hispano; two 75 I.G. drop tanks; two 500 lb.bombs or 10×60 lb. rockets.
Sea Vixen F.1	2	Avon 208	10,000	50 0	55 7	10 9	648	2	28×2 in. R.P.; 4×Firestreak AAM and 2×150 I.G. tanks; or bombs, R.P. or tanks in lieu of AAMs.
Scimitar F.1	2	Avon 200 (RA.24)	11,250	37 2	55 4	15 3	—	1	4×30 mm. Aden; bombs (including tactical nuclear) or 2×100 I.G. and 2×230 I.G. tanks external.
Shackleton MR.3	4	Griffon 57A	2,420*	119 10	92 6	23 4	1,458	10	2×20 mm. cannon; bombs, mines, depth charges, torpedoes.
Valiant B(K).1	4	Avon 204 (RA.28)	9,500	114 4	108 3	32 2	2,362	6–7	1×10,000 lb. or 21×1,000 lb. bombs; 2×1,615 I.G. tanks.
Victor B.1	4	Sapphire 200 (ASSa.7)	11,000	110 0	114 11	28 1½	—	5	Internal bombs; 2 external wing tanks.
Victor B.2	4	Conway RCo.11	17,250	120 0	114 11	28 1½	—	5	Internal bombs or Blue Steel ASM; 2 external wing tanks.
Vulcan B.1	4	Olympus 104 (BOI.12)	13,500	99 0	97 1	26 1	3,554	5	Internal bombs.
Vulcan B.2	4	Olympus 201 (BOI.7)	17,000	111 0	99 11	27 2	3,964	5	Internal bombs or Blue Steel ASM.

*—b.h.p.

AIRCRAFT	WEIGHTS Tare	WEIGHTS Basic Op.	WEIGHTS Total fuel	WEIGHTS Max. war-load	WEIGHTS Max. take-off	WEIGHTS Max. landing	PERFORMANCE Max. level speed Speed	Alt.	Wt.	T.-o. to 50 ft.	Landing from 50 ft.	Initial rate of climb		Service ceiling		No reserve range With max. fuel		With max. load		Operational radius	Typical endurance
	lb.	lb.	lb.	lb.	lb.	lb.	k.	ft.	lb.	ft.	ft.	ft./min.	lb.	ft.	lb.	n. mi.	Imp. g.	n. mi.	lb.	n. mi.	hr.
Blackburn NA.39	—	—	—	—	*42,000*	—	M.95	—	—	—	—	—	—	—	—	*1,200*	—	—	—	—	—
Canberra B.2	20,842	22,995	14,936	6,000	46,000	40,000	470	40,000	37,000	4,590	4,500	3,800	44,000	48,000	30,000	2,600	1,865	2,310	6,000	1,155	5.5
Canberra PR.3	21,046	22,784	19,266	—	46,000	40,000	470	40,000	37,000	4,410	4,500	3,800	44,000	48,000	30,000	3,180	2,405	3,120	1,851	1,560	7.25
Canberra B.6	21,679	22,950	22,120	8,000	55,000	40,000	470	40,000	44,000	5,800	3,900	3,500	58,000	48,000*	36,000	3,294	2,765	2,960	8,000	1,480	7
Canberra PR.7	21,713	23,042	26,440	3,100	55,000	40,000	470	40,000	44,000	5,650	3,900	3,500	55,000	48,000*	36,000	3,820	3,305	3,717	3,100	1,858	8.5
Canberra B(I).8	23,173	26,396	22,120	5,318	56,250	40,000	470	40,000	44,000	6,000	3,900	3,400	56,250	48,000*	36,000	3,155	2,765	700†	3,318	350†	2.25†
Canberra PR.9	—	—	—	—	*58,000*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Gannet AEW.3	—	—	—	—	*21,000*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Gannet AS.4	14,528	15,819	3,704	—	21,600	19,800	270	5,000	21,000	2,500	—	2,000	21,600	25,000	21,000	—	—	—	—	—	4
Gnat F.1	—	4,600	2,660	1,300	2,885	5,600	560	35,000	—	4,550	3,500	15,000	6,650	50,000	—	—	—	—	—	500	2.5
Hunter F.6/FGA.9	13,270	—	—	7,400	24,000	16,750	621	36,000	—	2,250	2,550	17,500	17,750	55,000	—	1,600	1,052	—	—	500	—
Hunter FR.10	—	—	—	7,250	24,000	16,750	621	36,000	—	2,250	2,550	17,500	17,750	55,000	—	1,600	1,052	—	—	—	—
Javelin FAW.1/4/5	—	—	—	—	*35,000*	—	M.90	*35,000*	—	—	—	*10,000*	—	*50,000*	—	—	—	—	—	—	2
Javelin FAW.2/6	—	—	—	—	*35,000*	—	M.90	*35,000*	—	—	—	*10,000*	—	*50,000*	—	—	—	—	—	—	2
Javelin FAW.8	—	—	—	—	*38,000*	—	M.94	*35,000*	—	—	—	*12,000*	—	*60,000*	—	—	—	—	—	—	2
Javelin FAW.9	—	—	—	—	*38,000*	—	M.94	*35,000*	—	—	—	*12,000*	—	*60,000*	—	—	—	—	—	—	2
Lightning F.1	—	—	—	—	*40,000*	—	M2.1	—	—	—	—	—	—	*60,000*	—	—	—	—	—	—	*1.25*
Sea Hawk FGA.6	10,300	—	—	1,000	16,200	13,300	500	10,000	15,200	5,790	4,080	5,050	15,200	—	—	—	—	—	—	250	—
Sea Vixen F.1	—	—	—	—	*35,000*	—	M.90	—	—	—	—	—	—	*50,000*	—	—	—	—	—	—	*1.5*
Scimitar F.1	—	—	—	—	*33,000*	—	M.95	—	—	—	—	—	—	*50,000*	—	—	—	—	—	—	*1.5*
Shackleton MR.3	57,800	—	33,466	—	100,000	86,000	262	12,000	85,000	4,750	6,000	850	100,000	19,200	100,000	3,660	4,650	—	—	1,540	24
Valiant B(K).1	75,881	77,408	51,913	21,000‡	138,000	98,000	M.84	30,000	110,000	4,700	5,500	4,000	140,000	54,000	140,000	3,920	9,972‡	3,000	10,000	1,500	—
Victor B.1	—	—	—	—	*160,000*	—	M.94	*40,000*	—	—	—	—	—	48,000*	—	—	—	—	—	—	6
Victor B.2	—	—	—	—	*200,000*	—	M.94	*40,000*	—	—	—	—	—	*60,000*	—	—	—	—	—	—	8
Vulcan B.1	—	—	—	—	*160,000*	—	M.94	*40,000*	—	—	—	—	—	48,000*	—	—	—	—	—	—	6
Vulcan B.2	—	—	—	—	*200,000*	—	M.94	*40,000*	—	—	—	—	—	*60,000*	—	—	—	—	—	—	8

* Limited by crew survival equipment. † Typical interdictor mission at 2,000 ft. with 10 min. combat at full power over target. ‡ Overload conditions with external tanks; max. wt. 175,000 lb. All data in italics are assumed.

British Aircraft Industry Data Sheets . . .

Non-offensive Military and Research Aeroplanes

AIRCRAFT	POWERPLANT			DIMENSIONS				Accommodation		ARMAMENT STORES, ETC.
	No.	Type	T.-o. power (each)	Span	Length o.a.	Height o.a.	Gross wing area	Crew	Pass.	
			lb.s.t. or e.h.p.	ft. in.	ft. in.	ft. in.	sq. ft.			
Argosy AW.660	4	Dart RDa.8	2,500	115 0	86 9	27 0	1,458	—	—	Unarmed. Equipped to air-drop paratroops and supplies.
Auster AOP.9	1	Bombadier 203	180	36 5	23 8½	8 11	197.6	2	1	Unarmed. Equipment for A.O.P., casualty evacuation, photography, cable laying as required.
Beverley C.1	4	Centaurus 173	2,850	162 0	99 5	38 9	2,916	4	94	Unarmed. Equipped to air-drop paratroops and supplies.
Bristol 188	2	Gyron Junior DGJ.10R	10,000	35 1	71 0	13 11½	396	1	—	Unarmed supersonic research with all-steel airframe.
Britannia C.1	4	Proteus 255	4,310	142 3½	124 3	37 6	2,075	5	113	Unarmed. No external stores.
Britannic	4	Tyne R.Ty.12	5,730	158 9½	136 5	47 0	2,466	4	255	Unarmed.
Canberra T.4	2	Avon 1 (RA.3)	6,500	64 0	65 6	15 7	960	3	—	Unarmed. Provision for 2×250 l.G. tip tanks.
Canberra U.10	2	Avon 1 (RA.3)	6,500	64 0	65 6	15 7	960	(2)	—	Unarmed drone conversion of Canberra B2.
Canberra T.11	2	Avon 1 (RA.3)	6,500	64 0	69 9	15 7	960	4	—	Unarmed. A.I. nose radar. Provision for 2×250 l.G. tip tanks.
Firefly U.9	1	Griffon 74	2,045	44 6	38 3	13 2	345	(1)	—	Unarmed drone. Provision for flares.
Gannet T.5	1	Double Mamba 101	3,035	54 4	42 11	13 9	490	2	2	Internal bombs, mines, depth charges, etc.; external rockets, depth charges, sonobuoys, etc.
Gnat	1	Orpheus 100 (BOr.4)	4,230	24 0	30 9	9 8	175	2	—	Unarmed. Two 66-gallon drop tanks.
Hunter T.7/T.8	1	Avon 122 (RA.21)	7,700	33 8	48 10½	13 2	349	2	—	1×30 mm. Aden (150 r.p.g.); 2×1,000 lb. and 2×500 lb. bombs or R.P. pods or 4×100 l.G. tanks.
Hunter T.66A	1	Avon 203/207 (RA.28)	10,000	33 8	48 10½	13 2	349	2	—	2×30 mm. Aden (150 r.p.g.); 2×1,000 lb. and 2×500 lb. bombs or R.P. pods or 2×100 and 2×230 l.G. tanks.
Javelin T.3	2	Sapphire 102/103 (ASSa.6)	8,300	52 0	60 2	16 0	928	2	—	4×30 mm. Aden. 2×250 l.G. ventral tanks.
Jet Provost T.3	1	Viper 102 (ASV.8)	1,750	36 11	32 5	10 2	213.7	2	—	2×0.303 m.g. (600 r.p.g.); practice bombs or R.P. on T.51 reduce performance by 30%.
Jet Provost T.4	1	Viper 200 (ASV.11)	2,500	36 11	32 5	10 2	213.7	2	—	Armament as T.51 above optional.
Lightning T.4	2	Avon 200 (RA24R)	14,430	34 10	50 0	19 7	—	2	—	2×30 mm. Aden; 2×Firestreak AAM or 48×2 in. rockets.
Meteor U.15	2	Derwent 5	3,500	43 0	41 3	13 0	374	(1)	—	Unarmed drone conversion of Meteor F.4.
Meteor U.16	2	Derwent 8/9	3,600	43 0	44 0	13 0	374	(1)	—	Unarmed drone conversion of Meteor F.8.
Short SC.1	5	RB.108	2,010	23 6	24 5	10 8	211.5	1	—	Unarmed VTOL research.
Twin Pioneer	2	Leonides 138	625	76 6	45 3	12 3	670	2	16	2×1,000 lb. bombs; para-supply packs; practice bombs on external racks.

AIRCRAFT	WEIGHTS						PERFORMANCE													
	Tare	Basic Op.	Total fuel	Max. war-load	Max. take-off	Max. landing	Max. level speed			T.-o. to 50 ft.	Landing from 50 ft.	Initial rate of climb		Service ceiling		No reserve range				Opera-tional radius	Typical endur-ance
							Speed	Alt.	Wt.							With max. fuel		With max. load			
	lb.	lb.	lb.	lb.	lb.	lb.	k.	ft.	lb.	ft.	ft.	ft./min.	lb.	ft.	lb.	n. mi.	Imp. g.	n. mi.	lb.	n. mi.	hr.
Argosy AW.660	—	—	—	—	100,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Auster AOP.9	—	1,543	—	582	2,125	—	110	S.L.	2,125	675	600	920	2,125	—	—	208	15	—	—	—	—
Beverley C.1	83,000	86,000	47,450	43,000	135,000	135,000	186	15,000	100,000	3,480	2,820	700	135,000	15,700	135,000	3,000	6,590	200	45,000	1,000	17.5
Bristol 188	—	—	—	—	—	—	M2.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Britannia C.1	—	96,826	68,376	37,417	185,000	137,000	349	21,000	150,000	6,800	3,600	1,300	185,000	30,000	150,000	4,540	—	3,620	37,417	—	14.8
Britannic	107,185	114,000	81,200	85,000	218,000	205,000	334	22,000	140,000	6,900	4,000	1,120	218,000	30,000	170,000	5,490	10,150	1,030	85,000	—	19.25
Canberra T.4	20,342	21,661	14,920	—	38,000	31,500	470	40,000	38,000	3,120	3,450	6,100	38,000	48,000*	31,500	2,702	1,865	—	—	1,351	6.25
Canberra U.10	—	22,441	11,016	—	34,000	—	M.78	25,000	—	2,550	—	6,500	33,000	55,000	30,000	—	—	—	—	—	—
Canberra T.11	21,464	24,381	14,936	—	46,000	40,000	470	40,000	38,000	3,120	3,450	6,100	38,000	48,000*	31,500	2,702	1,865	—	—	1,351	6.25
Firefly U.9	11,556	12,358	1,843	—	16,000	13,000	160	15,000	14,065	—	—	1,500	14,310	—	—	—	—	—	—	—	3
Gannet T.5	14,576	15,225	3,704	—	21,600	19,800	270	5,000	21,000	2,500	—	2,500	21,600	25,000	21,000	—	—	—	—	—	4
Gnat	—	5,470	3,020	—	8,970	7,600	545	35,000	—	3,240	3,900	8,000	7,850	48,000	—	—	—	—	—	—	2.25
Hunter T.7/T.8	12,950	—	—	5,400	22,000	16,750	610	36,000	—	2,850	2,850	12,000	17,200	50,000	—	1,100	814	—	—	400	—
Hunter T.66A	13,150	—	—	7,100	23,500	16,750	620	36,000	—	2,250	2,550	15,000	17,600	55,000	—	1,600	1,052	—	—	500	—
Javelin T.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jet Provost T.3	—	4,607	2,140	—	7,110	6,350	295	30,000	—	2,750	2,550	1,980	—	—	—	570	278	—	—	—	2.78
Jet Provost T.4	—	4,707	2,140	—	7,200	6,350	355	30,000	—	2,150	2,565	3,340	—	—	—	600	278	—	—	—	2.75
Lightning T.4	—	—	—	—	—	—	M2.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Meteor U.15	11,000	—	4,100	—	18,800	14,700	350	2,000	Max.	3,200	—	6,000	18,000	38,000	—	—	—	—	—	—	0.9
Meteor U.16	—	14,800	4,100	—	19,400	14,700	485	1,000	Max.	3,610	3,200	8,000	19,000	41,000	—	—	—	—	—	—	2.3
Short SC.1	—	—	—	—	7,800	7,800	—	—	—	Zero	Zero	—	—	—	—	—	—	—	—	—	—
Twin Pioneer	9,880	—	1,780	4,000	14,600	14,600	145	2,000	14,600	1,150	1,150	1,250	14,600	19,000	14,600	662	247	75	4,000	—	5.8

* Limited by crew survival equipment.

British Aircraft Industry Data Sheets . . .

Light and General Aeroplanes

Aircraft	POWERPLANT				Total seats	DIMENSIONS				WEIGHTS					PERFORMANCE									
	No.	Type	T.-o. power			Span	Length o.a.	Height o.a.	Wing area	Empty	Max. fuel	Max. pay-load	Max. t.-o.	Max. land-ing	Cruising speed			T.-o. to 50 ft.	Landing from 50 ft.	Initial climb		Service ceiling		Max. range
			b.h.p.	r.p.m.		ft. in.	ft. in.	ft. in.	sq. ft.	lb.	lb.	lb.	lb.	lb.	k.	ft.	lb.	ft.	ft.	ft./min.	lb.	ft.	lb.	n. mi.
Auster D.4/108	1	Lycoming O-235-C	108	—	2	36 0	23 4	—	184.5	1,232	—	—	1,900	—	81	1,500	1,750	1,185	1,245	620	1,750	13,200	—	435
Auster D.6/180	1	Lycoming O-360	180	—	4	36 0	23 4	—	184.5	1,450	—	—	2,500	—	115	5,000	2,400	1,680	—	850	2,480	—	—	425
Beaver	1	P. & W. R-985	450	—	9	48 0	30 4	—	—	2,960	560	1,580	5,100	—	113	5,000	5,100	1,015	1,000	1,020	5,100	18,000	5,100	600
Dove 8	2	Gipsy Queen 70 Mk. 3	400	3,000	8	57 0	39 6	13 4	335	6,580	1,545	1,899	8,950	8,500	162	8,000	8,500	2,270	1,920	1,420	8,950	—	—	1,175
Jackaroo	1	Gipsy Major 1	120	2,100	4	30 4	25 5	8 10	247	1,760	—	—	2,180	—	80	3,000	2,180	—	—	500	2,180	11,000	2,180	200
Jackaroo (Agricultural)	1	Gipsy Major 1	120	2,100	2	30 4	25 5	8 10	247	—	—	—	2,180	—	80	3,000	2,180	—	—	500	2,180	11,000	2,180	200
Linnet	1	Continental C90-F	90	—	2	26 4	20 9	—	117	835	—	—	1,350	—	101	6,000	—	600*	525*	720	—	11,500	—	600
Luton Minor	1	Aeronca J.A.P. 99	37	2,250	1	25 0	20 0	—	125	390	52	260	650	—	65	—	600	240*	120*	450	630	—	—	160
Luton Major	1	Lycoming 55	62	—	2	35 4	23 9	—	163	600	88	500	1,100	—	83	4,500	1,000	240*	150*	700	1,000	—	—	300
Otter	1	P. & W. R-1340	600	—	13	58 0	41 10	13 0	—	4,368	1,282	3,220	8,000	—	111	5,000	—	1,310	975	735	8,000	17,400	8,000	755
Prospector 1	1	Lycoming GO 480	295	3,400	6	43 6	29 9	8 9	228	2,100	400	1,500	3,700	3,700	105	2,000	3,700	900	900	960	3,700	14,000	3,700	455
Prospector 2	1	Cheetah X	410	2,300	6	43 6	29 9	8 9	228	2,760	400	1,356	4,300	4,000	112	S.L.	4,000	900	950	1,300	4,300	—	—	390
Skyvan (SC.7)	2	Continental GTS IO-520	390	3,400	17	64 1	38 11	13 10	373	5,330	1,080	3,000	8,600	8,600	140	10,000	8,000	1,320	1,600	1,410	8,600	2,500	8,600	850
Student	1	Marboré IIA	880	—	2	29 2	31 6	6 3	144	2,400	—	—	3,900	—	227	20,000	3,500	2,220	1,920	1,780	3,500	—	—	540
Turbulent	1	Ardem 4CO2	40	3,000	1	21 7	17 5	5 0	77.5	350	57	95	—	—	75	1,500	600	700	400	600	600	7,000	600	300
Workmaster	1	Lycoming O-360A	180	—	4	36 0	23 5	8 1½	185	—	—	—	2,650	—	89	S.L.	2,550	720	345*	850	2,500	15,000	2,550	365

* Ground run.

Helicopters

AIRCRAFT	POWER PLANT			Total seats	DIMENSIONS				WEIGHTS					PERFORMANCE										
	No.	Type	T.-o. power (each)		Rotor dia.	Length o.a.	Height o.a.	Disc area	Tare	Fuel	Pay-load	Normal gross		Typical cruise			Initial climb		Service ceiling		Hovering ceiling		Max. range
			h.p.		ft.	ft.	ft.	sq. ft.	lb.	lb.	lb.	lb.		k.	ft.	lb.	ft./min.	lb.	ft.	lb.	ft.	lb.	n. mi.
Belvedere	2	Gazelle 100 (NGa.2)	1,650	21	48 11	90 0	17 3	1,860	11,390	4,530	6,000	18,500		120	S.L.	18,500	1,350	18,500	17,300	18,500	11,000*	18,500	400
Skeeter AOP. 12	1	Gipsy Major 140	215	2	32 0	39 0	9 0	804	1,656	176	358	2,200		88	S.L.	2,200	1,150	2,280	12,800	2,200	5,500*	2,200	140
Skeeter	1	Turmo 603	250	2	32 0	39 0	7 6	804	1,572	405	198	2,350		90	S.L.	2,350	1,420	2,350	18,000	2,350	15,000	2,350	112
Sprite	1	Nimbus	650	6	32 3	39 8	10 4	815	2,836	1,280	900	5,000		100	S.L.	5,000	1,490	5,000	20,000	5,000	10,000	5,000	249
Wasp	1	Gnome H.1000	900	6	32 3	39 8	10 4	815	2,836	1,280	900	5,000		100	S.L.	5,000	—	—	20,000	5,000	—	—	266
Wessex HAS. 1	1	Gazelle 160 (NGa.13)	1,450	14	56 0	65 10	15 11	2,460	7,600	2,430	4,000	12,600		115	S.L.	12,600	1,750	12,600	14,200	12,600	7,000*	12,600	340
Wessex 2	2	Gnome H. 1200	1,250	—	56 0	65 10	15 11	2,460	7,842	2,430	5,600	13,500		115	S.L.	13,500	1,500	13,500	20,000	13,500	10,000	13,500	300
Westminster	2	Eland E.229A	3,150	—	72 0	89 3	18 4	4,071	21,345	7,452	3,548	36,000		130	S.L.	33,500	2,350	33,500	—	—	5,000	33,500	200
Whirlwind Srs. 1	1	P. & W. R-1340-40	600	9	53 0	59 6	15 6	2,206	4,990	1,044	2,000	7,500		80	S.L.	7,500	520	7,500	7,500	7,500	4,600*	7,500	255
Whirlwind Srs. 2	1	Leonides Major	720	9	53 0	59 6	15 6	2,206	5,375	1,044	2,000	8,000		86	S.L.	8,000	1,100	8,000	15,700	8,000	9,400*	8,000	290
Whirlwind HAR. 10	1	Gnome H.1000	1,050	11	53 0	62 4.5	15 6	2,206	4,694	1,450	3,406	8,000		90	S.L.	8,000	1,200	8,000	15,200	8,000	14,500*	8,000	245
Widgeon	1	Leonides 521/2	500	5	49 2	57 8	13 4	1,900	4,322	600	1,000	5,900		88	—	5,900	780	5,900	12,000	5,900	4,080	5,900	260

* In ground effect.

British Aircraft Industry Data Sheets . . .

Turbine Engines

Engines		Compressor				No. of combustion chambers	No. of turbine stages	Sea level static performance									Overall dimensions			Dry weight	Power/weight ratio
								Take-off					Maximum continuous								
Make and name	Type	Type	Stages	Pressure ratio	Air mass flow			lb. th.	s.h.p.	e.h.p.	r.p.m.	lb./*/hr.	lb. th.	s.h.p.	r.p.m.	lb./*/hr.	Length of engine	Length with ex. cone	Width or height		
					lb./sec.												in.	in.	in.	lb.	*/lb. wt.
Blackburn Engines, Ltd.																					
Turmo 603	S.T.	C.	1	3.86 : 1	7.26	Ann.	1+1	N.A.	425	N.A.	34,000	1.105	N.A.	375	33,000	1.13	47.9	N.A.	26.4	370	1.15
Artouste 600	S.T.	C.	1	4.00 : 1	7.27	Ann.	2	N.A.	472	N.A.	35,000	0.98	N.A.	414	34,000	1.03	N.A.	54.0	17.5	295	1.60
A 129 (Nimbus)	S.T.	Ax.+C.	2+1	6.50 : 1	11.0	Ann.	2+1	N.A.	968	N.A.	35,000	0.681	N.A.	815	34,000	0.718	60.0	N.A.	20.0	390	2.15
Palouste 505	G.G.	C.	1	3.81 : 1	7.70	Ann.	2	N.A.	—	N.A.	35,000	1.26	—	N.A.	N.A.	N.A.	33.4	N.A.	17.5	214	N.A.
Bristol Siddeley Engines, Ltd.																					
Viper ASV.8	Tj.	Ax.	7	4.1 : 1	32.0	Ann.	1	1,750	—	—	13,800	1.07	1,480	—	13,100	1.075	N.A.	66.98	23.4	500	3.50
Viper ASV.11	Tj.	Ax.	7	4.3 : 1	44.0	Ann.	1	2,500	—	—	13,800	1.07	2,165	—	13,100	1.025	N.A.	63.997	24.55	549	4.57
Viper ASV.12	Tj.	Ax.	7	4.4 : 1	44.0	Ann.	1	2,700	—	—	13,800	1.10	2,320	—	13,100	1.055	N.A.	63.997	24.55	549	4.93
Orpheus 701 BOr.2	Tj.	Ax.	7	4.39 : 1	84.0	Cann. 7	1	4,700	—	—	10,000	1.08	4,130	—	9,500	1.06	N.A.	73.0	32.4	795	5.91
Orpheus 803 BOr.3	Tj.	Ax.	7	4.4 : 1	84.0	Cann. 7	1	5,000	—	—	10,000	1.085	4,200	—	9,470	1.07	N.A.	75.45	32.4	835	6.00
Orpheus 100 BOr.4	Tj.	Ax.	7	4.39 : 1	84.0	Cann. 7	1	4,230	—	—	10,000	0.99	3,600	—	9,600	0.98	N.A.	77.52	32.4	900	4.70
Orpheus BOr.12	Tj.	Ax.	8	5.7 : 1	107.0	Cann. 7	2	6,810	—	—	10,000	0.967	5,825	—	9,620	0.933	N.A.	81.40	32.4	1,180	5.79
Sapphire ASSa.7R	Tj.	Ax.	13	7.5 : 1	168.5	Ann.	2	12,230*a*	—	—	8,600	1.38	9,310	—	8,200	0.870	N.A.	83.475	37.4	3,110	3.94*a*
Olympus 104 BOl.12	Tj.	Ax. × Ax.	7×8	10.9 : 1	195.0	Cann.	1×1	13,500	—	—	N.A.	N.A.	13,000	—	N.A.	N.A.	N.A.	156.2	42.4	3,900	3.46
Olympus 201 BOl.7	Tj.	Ax. × Ax.	5×7	N.A.	N.A.	Cann.	1×1	17,000	—	—	N.A.	N.A.	15,250	—	N.A.	N.A.	N.A.	126.4	41.6	3,950	4.28
Olympus BOl.21	Tj.	Ax. × Ax.	6×7	N.A.	N.A.	Cann.	1×1	20,000	—	—	N.A.	N.A.	N.A.	—	N.A.	N.A.	N.A.	130.9	42.0	N.A.	N.A.
Double Mamba ASMD.8	Tp.	Ax.	11	5.8 : 1	2×21.0	Ann.	3	730	3,600	3,880	15,000	0.66	710	3,880*c*	15,000	0.66	N.A.	103.35	56.55	2,500	1.56
Proteus 765	Tp.	Ax. × C.	12×1	7.2 : 1	44.3	8	2×2	1,260	3,915	4,400	11,593	0.593	1,155	3,485	11,500	0.607	N.A.	100.6	40.1	2,900	1.52
Proteus 770	Tp.	Ax. × C.	12×1	7.2 : 1	44.3	8	2×2	1,260	4,130	4,615	11,775	0.565	1,155	3,680	11,500	0.578	N.A.	100.6	40.1	2,900	1.59
BS.53	L/Thrust	Ax.+Fan	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	—	N.A.	N.A.	N.A.	N.A.	—	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
BS.75	Tf.	Ax.	N.A.	N.A.	N.A.	N.A.	N.A.	7,350	—	N.A.	N.A.	N.A.	N.A.	—	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
de Havilland Engine Co., Ltd.																					
Gyron Junior DGJ.2 Mk. 101	Tj.	Ax.	N.A.	N.A.	N.A.	Ann.	N.A.	7,100	—	—	N.A.	N.A.	N.A.	—	N.A.	N.A.	N.A.	102.9	32.3	N.A.	N.A.
Gyron Junior DGJ.10	Tj.	Ax.	8	N.A.	N.A.	Ann.	N.A.	10,000	—	—	N.A.	N.A.	N.A.	—	N.A.	N.A.	70.0	N.A.	32.3	N.A.	N.A.
Gnome H.1000	S.T.	Ax.	10	8.3 : 1	12.4	Ann.	2+1	143	1,050	—	19,500*e*	0.64	125	900	19,500*e*	0.67	54.8	N.A.	18.2	1,303*k*	2.86
Gnome H.1200	S.T.	Ax.	10	8.3 : 1	12.5	Ann.	2+1	152	1,250	—	19,500*e*	0.624	133	1,050	19,500*e*	0.64	54.8	N.A.	18.2	328*k*	2.87
Gnome P.1200	Tp.	Ax.	10	8.3 : 1	12.5	Ann.	2+1	147	1,150	—	20,000*e*	0.65	134	1,000	19,000*e*	0.68	79.3	N.A.	17.0	630	1.83
D. Napier and Son, Ltd.																					
Eland 504	Tp.	Ax.	10	7.0 : 1	33.5	6	3	700	3,230	3,500	12,500	0.61	625	2,670	12,000	0.63	95.5	116.0	36.0	1,820	1.92
Eland E.211	S.T.	Ax.	10	7.0 : 1	33.5	6	3	550	3,500	3,710	12,500	0.60	520	2,850	12,500	0.63	135.0	N.A.	36.0	1,418	2.61
Gazelle NGa.2	S.T.	Ax.	11	6.25 : 1	16.8	6	2+1	260	1,650	1,750	20,000	0.677	190	1,210	18,600	0.711	70.5	N.A.	33.5	870	1.90
Gazelle NGa.13	S.T.	Cx.	11	5.9 : 1	16.1	6	2+1	230	1,450	1,540	19,400	0.69	190	1,200	18,600	0.714	70.0	N.A.	33.5	890	1.63
Gazelle 512	S.T.	Ax.	11	6.25 : 1	16.7	6	2+1	255	1,640	1,740	19,900	0.672	195	1,280	18,800	0.697	71.5	N.A.	29.5	675*k*	2.43
Rolls-Royce, Ltd.																					
Avon RA.24	Tj.	Ax.	N.A.	N.A.	N.A.	Cann. 8	N.A.	11,250	—	—	N.A.	N.A.	N.A.	—	N.A.	N.A.	N.A.	126.0	41.5	N.A.	N.A.
Avon RA.29/1	Tj.	Ax.	16	9.1 : 1	173.0	Cann. 8	3	10,500	—	—	8,050	0.770	9,125	—	7,650	0.739	N.A.	126.0	39.0	3,308	3.18
Avon RA.29/3	Tj.	Ax.	16	9.35 : 1	173.0	Cann. 8	3	11,400	—	—	8,050	0.805	9,500	—	7,750	0.748	N.A.	126.0	39.0	3,327	3.42
Avon RA.29/6	Tj.	Ax.	17	10.06 : 1	185	Cann. 8	3	12,200	—	—	8,050	0.762	10,820	—	7,850	0.724	N.A.	134.0	39.0	3,471	3.52
Avon RA.29/6	Tj.	Ax.	17	10.3 : 1	185	Cann. 8	3	12,725	—	—	8,150	0.779	10,820	—	7,850	0.724	N.A.	134.0	39.0	3,471	3.68
Avon RB.146	Tj.	Ax.	N.A.	N.A.	N.A.	Cann. 8	N.A.	13,220	—	—	N.A.	N.A.	N.A.	—	N.A.	N.A.	N.A.	145.0	41.5	N.A.	N.A.
Conway RCo.11 (up-rated)	B.P.	Ax. × Ax.	N.A.	N.A.	N.A.	Cann. 10	N.A.	17,250	—	—	N.A.	N.A.	N.A.	—	N.A.	N.A.	N.A.	136.0	42.0	N.A.	N.A.
Conway RCo.12	B.P.	Ax. × Ax.	7×9	14.1 : 1	281	Cann. 10	1×2	17,500	—	—	9,980	0.725	14,625	—	9,590	0.69	N.A.	136.0	42.0	4,542	3.86
Conway RCo.15	B.P.	Ax. × Ax.	7×9	14.3 : 1	295	Cann. 10	1×2	18,500	—	—	9,895	0.701	15,000	—	9,500	0.667	N.A.	136.0	42.0	4,582	4.05
Conway RCo.42	B.P.	Ax. × Ax.	N.A.	14.6 : 1	365	Cann. 10	1×2	20,250	—	—	9,955	0.622	16,500	—	9,575	0.592	N.A.	150.0	48.0	5,001	4.04
RB.108	Tj.	Ax.	N.A.	N.A.	N.A.	Ann.	N.A.	2,010	—	—	N.A.	N.A.	N.A.	—	N.A.	N.A.	N.A.	42.0	20.8	248	8.1
RB.141	B.P.	Ax. × Ax.	5×11	16.75 : 1	273	Cann. 10	—	15,000	—	—	9,895	0.599	14,100	—	9,725	0.585	N.A.	134.5	42.0	3,613	4.1
RB.145	Tj.	Ax.	N.A.	N.A.	N.A.	Ann.	N.A.	2,750	—	—	N.A.	N.A.	N.A.	—	N.A.	N.A.	N.A.	63.7	20.8	N.A.	N.A.
RB.163	B.P.	Ax. × Ax.	4×12	16.8 : 1	202	Cann. 10	2×2	9,850	—	—	12,490	0.560	9,450	—	12,260	0.545	N.A.	110.0	37.0	2,200	4.48
													e.h.p.								
Dart RDa.3 Mk. 506	Tp.	C.	2	5.4 : 1	20.5	7	2	—	1,345	1,480	14,500	0.755	*1,188*	1,075	13,800	0.816	N.A.	95.0	38.0	1,026	1.5
Dart RDa.6 Mk. 510	Tp.	C.	2	5.4 : 1	20.5	7	2	—	1,535	1,675	14,500	0.717	*1,432*	1,310	14,000	0.753	N.A.	98.0	38.0	1,106	1.64
Dart RDa.6 Mk. 511	Tp.	C.	2	5.4 : 1	20.5	7	2	—	1,535	1,650	14,500	.0725	*1,650*	1,535	14,500	0.725	N.A.	98.0	38.0	1,106	1.64
Dart RDa.6 Mk. 514	Tp.	C.	2	5.4 : 1	20.5	7	2	—	1,535	1,650	14,500	0.725	*1,650*	1,535	14,500	0.725	N.A.	98.0	38.0	1,114	1.62
Dart RDa.7 Mk. 520	Tp.	C.	2	5.6 : 1	23.5	7	3	—	1,630	1,815	15,000	0.726	*1,655*	1,495	14,500	0.736	N.A.	98.0	38.0	1,207	1.5
Dart RDa.7/1 Mk. 525	Tp.	C.	2	5.6 : 1	23.5	7	3	—	1,730	1,910	15,000	0.706	*1,750*	1,585	14,500	0.721	N.A.	98.0	38.0	1,227	1.56
Dart RDa.7/2 Mk. 526 and 527	Tp.	C.	2	5.6 : 1	23.5	7	3	—	1,835	2,020	15,000	0.690	*2,020*	1,835	15,000	0.690	N.A.	98.0	38.0	1,227	1.65
Dart RDa.7/2 Mk. 528	Tp.	C.	2	5.6 : 1	23.5	7	3	—	1,835	2,020	15,000	0.690	*2,020*	1,835	15,000	0.690	N.A.	98.0	38.0	1,223	1.66
Dart RDa.7/2 Mk. 529	Tp.	C.	2	5.6 : 1	23.5	7	3	—	1,910	2,100	15,000	0.710	*2,100*	1,910	15,000	0.710	N.A.	98.0	38.0	1,227	1.71
Dart RDa.7/2 Mks. 530 and 531	Tp.	C.	2	5.6 : 1	23.5	7	3	—	1,835	2,020	15,000	0.690	*2,020*	1,835	15,000	0.690	N.A.	98.0	38.0	1,227	1.65
Dart RDa.10	Tp.	C.	2	6.35 : 1	27	7	3	—	2,305	2,555	15,000	0.663	*2,555*	2,305	15,000	0.663	N.A.	98.0	38.0	1,376	1.86
Dart RDa.10/1 Mk. 542	Tp.	C.	2	6.35 : 1	27	7	3	—	2,750	3,030	15,000	N.A.	*2,555*	2,305	15,000	0.663	N.A.	98.0	38.0	1,376	2.2
Tyne RTy.1 Mk. 506	Tp.	Ax. × Ax.	6×9	13.5 : 1	46.5	Can. 10	1×3	—	4,320	4,785	15,250	0.505	*4,190*	3,835	13,500	0.505	N.A.	108.7	43.2	2,275	2.11
Tyne RTy.11 Mk. 512	Tp.	Ax. × Ax.	6×9	13.5 : 1	46.5	Cann. 10	1×3	—	4,850	5,325	15,250	0.482	*4,670*	4,270	14,100	0.488	N.A.	108.7	43.2	2,275	2.34
Tyne RTy.12 Mk. 515	Tp.	Ax. × Ax.	6×9	13.5 : 1	46.5	Cann. 10	1×3	—	5,095	5,500	15,250	0.466	*5,050*	4,685	14,500	0.472	N.A.	108.7	43.2	2,177	2.53

Note.—Take-off thrusts and powers quoted for Rolls-Royce turbojets and turboprops are minimum figures; maximum continuous e.h.p.s are shown in italics because residual thrusts are not quoted. Abbreviations.—Ann., annular; Ax., axial; B.P., by-pass engine; C., centrifugal; Cann., cannular; G.G., gas generator; N.A., not available; S.T., shaft-turbine engine; Tf., turbofan; Tj., turbojet; Tp., turboprop; * lb. thrust, s.h.p., e.h.p. or g.h.p. as applicable to respective type of engine; *a* with afterburner; *c*, e.h.p.; *e*, power turbine r.p.m.; *k*, without reduction gears.

British Aircraft Industry Data Sheets . . .

Piston Engines

Engine Make and name	Type	No. of cyls.	Dimensions Swept volume	Length	Width	Height	Dry weight	Comp. ratio	Performance Take-off b.h.p.	Take-off r.p.m.	Max. continuous b.h.p.	Max. continuous r.p.m.	Max. continuous ft.	Fuel consumption
Alvis, Ltd.			cu. in.	in.	in.	in.	lb.							g.p.h.
Leonides 514/8A	R.	9	718.6	54.4	41.5	41.5	795	6.5 : 1	550	3,000	495	2,900	3,750	23.5
Leonides 521/2*	R.	9	718.6	54.96	41.5	41.5	790	6.5 : 1	500	3,000	405	2,800	8,250	N.A.
Leonides 531/8	R.	9	783.3	54.4	43.0	43.0	860	6.5 : 1	640	3,200	585	3,000	2,500	26.0
Leonides 553/1*	R.	9	783.3	54.96	43.0	43.0	850	6.5 : 1	640	3,200	585	3,000	2,500	26.0
Leonides Major Mk. 155*	2R.	14	1,117.8	54.9	38.9	38.9	1,110	6.8 : 1	755 min.	2,900	705	2,900	6,750	44.0
Leonides Major 702/1	2R.	14	1,117.8	62.06	38.9	38.9	1,200	6.8 : 1	875	3,000	750	2,900	5,500	34.0
Blackburn Engines, Ltd.														
Bombardier 702/208	I.L.	4	398	45.9	18.6	31.5	375	7 : 1	180	2,600	155	2,300	1,250	10.5
Bristol Siddeley Engines, Ltd.														
Centaurus 661	2R.	18	3,270	74.6	55.3	55.3	3,460	7.2 : 1	2,625	2,800	2,265(M) 2,110(S)	2,500(M) 2,500(S)	5,500(M) 12,000(S)	85.0
de Havilland Engine Co., Ltd.														
Gipsy Queen 70 Mk. 3	I.L.	6	622	71.75	19.56	33.23	708	6.5 : 1	400	3,000	355	2,700	4,250	17.5
Gipsy Major 215*	I.L.	4	416	51.0	16.8	29.8	415	7.25 : 1	215	2,850	207	2,700	S.L.	10.3

Abbreviations.— I.L., in-line; (M), medium supercharger speed; N.A., not available; (S), fast supercharger speed; S.L., sea level; R., radial; *, helicopter engine.

Rocket Engines

Engine Make and name	Duty	No. of comb. chamb.	Propellents Oxidant	Fuel	Coolant	Max. thrust	Propellent supply means	Normal firing time	Overall dimensions Length	Width	Dry weight
Bristol Siddeley Engines, Ltd.						lb.		sec.	in.	in.	lb.
PR.23	M.T.	1	H.T.P.	Kerosene	—	800	—	A.T.	39.0	4.25	32
Gamma Mk. 201	M.P.	4	H.T.P.	Kerosene	H.T.P.	19,000	Turbo-pumps	A.T.	38.0	36.0	700
Stentor BSSt.1	M.P.	2	H.T.P.	Kerosene	H.T.P.	N.A.	Turbo-pumps	A.T.	N.A.	N.A.	N.A.
de Havilland Engine Co., Ltd.											
Spectre D.Spe.5	A.F.	1	H.T.P.	Kerosene	H.T.P.	8,000	Turbo-pumps	A.T.	56.5	24.0	431
Spectre D.Spe.4	A.T.O.	1	H.T.P.	Kerosene	H.T.P.	8,000	Turbo-pumps	N.A.	59.2	21.5	1,393
Double Spectre D.Spe.D.1	A.F./M.P.	2	H.T.P.	Kerosene	H.T.P.	16,000	Turbo-pumps	A.T.	58.6	36.6	N.A.
D. Napier and Son, Ltd.											
Triple Scorpion	A.F./M.P.	3	H.T.P.	Kerosene	H.T.P.	7,000–9,000	Turbo-pumps	A.T.	35.0	21.5	295
Double Scorpion	A.F./M.P.	2	H.T.P.	Kerosene	H.T.P.	4,000–6,000	Turbo-pumps	A.T.	35.0	23.0	216.4
Single Scorpion	A.F./M.P.	1	H.T.P.	Kerosene	H.T.P.	2,000–3,000	Turbo-pumps	A.T.	35.0	16.5	140

Abbreviations.—A.F., Aircraft flight rocket engine; A.T., according to tank capacity; A.T.O., assisted take-off unit; H.T.P., high-test hydrogen peroxide; M.P., missile powerplant; M.T., missile trimmer engine; N.A., not available; *, chamber only.

Ramjets

Make and name	Duty	Fuel	Performance Thrust	Speed	Height	Consumption	Dimensions Length	Diameter	Dry weight
Bristol Siddeley Engines, Ltd.			lb.		ft.		in.	in.	lb.
Thor BT.2 (in Bristol/Ferranti Bloodhound)	M.P.	Kerosene	*16,500*	M=3	S.L.	N.A.	91.5	15.75	N.A.
BSRJ.824	M.P.	Kerosene	N.A.	N.A.	N.A.	N.A.	N.A.	18.0	N.A.

Abbreviations.—A.F., Aircraft flight ramjet engine; M.P., Missile powerplant; N.A., not available; S.L., Sea level. Data in italics are estimated.

Missiles and Research Vehicles

Missile Prime Contractor and Name	Type	Status	Powerplant	Guidance	Length	Weight	Speed	Max. range
					ft. in.	lb.	Mach No.	miles
Armstrong Whitworth Seaslug Mk. 1	SAM	Prod.	1×I.C.I. (S.P.); 4 S.P. wrapped boosters	B–R. (G.E.C.)	19 8	N.A.	N.A.	N.A.
Avro Blue Steel	ASM	Dev.	1 Bristol Siddeley Stentor BSSt. 1 rocket engine (L.P.)	In. (Elliott)	35 0	*15,000*	*1.6*	*100+*
Bristol/Ferranti Bloodhound Mk. 1	SAM	Opl.	2×Bristol Siddeley Thor (Rj); 4×S.P. wrapped boosters.	Semi-active homing (Ferranti)	25 0	N.A.	N.A.	N.A.
de Havilland Propellers Blue Streak	?	Dev.	1×two-chamber Rolls-Royce rocket engine (L.P.)		70 0	*200,000*	N.A.	*2,500 n.m.*
de Havilland Propellers Firestreak Mk. 1	AAM	Opl.	S.P.	I–R.	10 5½	300	2.0+	4+
de Havilland Propellers Red Top	AAM	Dev.	N.A.	I–R.	N.A.	N.A.	N.A.	8
English Electric Blue Water	SSM	Dev.	S.P.	In.	N.A.	N.A.	N.A.	N.A.
English Electric Thunderbird Mk. 1	SAM	Opl.	1×S.P.; 4×S.P. wrapped boosters	Semi-active homing (Marconi)	20 8	N.A.	N.A.	N.A.
Malkara (Australian Government Aircraft Factories)	Anti-tank	Prod.	2-st. S.P.	Wire Cd.	6 3½	206	N.A.	2
Pye Python	Anti-tank	Dev.	2-st. Bristol-Aerojet (S.P.)	Wire Cd.	5 0	80	N.A.	N.A.
Saunders-Roe Black Knight (re-entry research vehicle)		Prod.	1×16,400 lb.s.t. B.S. Gamma	Elem. pitch programmer	35 0	N.A.	N.A.	500 alt.
S.R. Black Knight (two-stage)		Prod.	1×16,400 lb.s.t. B.S. Gamma+1×S.P.	Elem. pitch programmer	N.A.	N.A.	N.A.	1,000–1,500 alt.
Skylark (upper-air research vehicle)		Prod.	1×12,000 lb.s.t. Raven (S.P.)+optional 20,000 lb.s.t. Cuckoo booster	None	25 0 (no booster)	2,560 (no booster)	5.0	100–180 alt.
Short Seacat	SAM	Dev.	2-st. S.P.	Radio Cd.	*4 10*	N.A.	N.A.	N.A.
Vickers Vigilant	Anti-tank	Dev.	2-st. I.C.I. (S.P.)	Wire Cd.	1 11½	26	*350 m.p.h.*	*1*

Abbreviations.—B–R., beam-riding; Cd., command; Dev., under development; In., inertial; I–R., infra-red; L.P., liquid-propellent; N.A., not available; Opl., operational; Prod., in production, not yet opl.; Rj., ram-jet; S.P., solid propellent; st., stage; s.t., static thrust. Data in italics are estimated or approximate.

converts

fighter to tanker

in 60 minutes

THE Mk 20 refuelling pack

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R.A.F.
BENEVOLENT FUND
67 PORTLAND PLACE
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Tuck a Mk 20 Refuelling Pack under the wing of a single-seat fighter and it becomes a high-ceiling, high-speed aerial tanker. With the refuelling pack, Probe and Drogue in-flight refuelling is possible 40,000 ft. (12,200 metres) up, at 300 knots (566 k.p.h.) indicated, and at the rate of 150 gallons per minute (680 litres per minute).

In just 60 minutes this compact self-powered ram-air turbine driven unit weighing only 800 lb dry weight (363 kgs) can be fitted to standard underwing pylons of fighter and strike aircraft. Removal of the store is even quicker. The refuelling pack's own capacity is 150 gallons (680 litres) but it can transfer as much fuel as the aircraft can carry. It speaks for the simplicity of the controls that the unit can be operated safely from a single-seat aircraft. The refuelling pack is built by Flight Refuelling Limited, the pioneers of the Probe and Drogue in-flight refuelling system.

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Piston Engines

Engine Make and name	Type	No. of cyls.	Dimensions: Swept volume	Length	Width	Height	Dry weight	Comp. ratio	Performance: Take-off b.h.p.	Take-off r.p.m.	Max. continuous b.h.p.	Max. continuous r.p.m.	Max. continuous ft.	Fuel consumption g.p.h.
Alvis, Ltd.			cu. in.	in.	in.	in.	lb.		b.h.p.	r.p.m.	b.h.p.	r.p.m.	ft.	g.p.h.
Leonides 514/8A	R.	9	718.6	54.4	41.5	41.5	795	6.5 : 1	550	3,000	495	2,900	3,750	23.5
Leonides 521/2*	R.	9	718.6	54.96	41.5	41.5	790	6.5 : 1	500	3,000	405	2,800	8,250	N.A.
Leonides 531/8	R.	9	783.3	54.4	43.0	43.0	860	6.5 : 1	640	3,200	585	3,000	2,500	26.0
Leonides 553/1*	R.	9	783.3	54.96	43.0	43.0	850	6.5 : 1	640	3,200	585	3,000	2,500	26.0
Leonides Major Mk. 155*	2R.	14	1,117.8	54.9	38.9	38.9	1,110	6.8 : 1	755 min.	2,900	705	2,900	6,750	44.0
Leonides Major 702/1	2R.	14	1,117.8	62.06	38.9	38.9	1,200	6.8 : 1	875	3,000	750	2,900	5,500	34.0
Blackburn Engines, Ltd.														
Bombardier 702/208	I.L.	4	398	45.9	18.6	31.5	375	7 : 1	180	2,600	155	2,300	1,250	10.5
Bristol Siddeley Engines, Ltd.														
Centaurus 661	2R.	18	3,270	74.6	55.3	55.3	3,460	7.2 : 1	2,625	2,800	2,265(M) 2,110(S)	2,500(M) 2,500(S)	5,500(M) 12,000(S)	85.0
de Havilland Engine Co., Ltd.														
Gipsy Queen 70 Mk. 3	I.L.	6	622	71.75	19.56	33.23	708	6.5 : 1	400	3,000	355	2,700	4,250	17.5
Gipsy Major 215*	I.L.	4	416	51.0	16.8	29.8	415	7.25 : 1	215	2,850	207	2,700	S.L.	10.3

Abbreviations.— I.L., in-line; (M), medium supercharger speed; N.A., not available; (S), fast supercharger speed; S.L., sea level; R., radial; *, helicopter engine.

Rocket Engines

Engine Make and name	Duty	No. of comb. chamb.	Propellents: Oxidant	Fuel	Coolant	Max. thrust	Propellent supply means	Normal firing time	Overall dimensions: Length	Width	Dry weight
Bristol Siddeley Engines, Ltd.						lb.		sec.	in.	in.	lb.
PR.23	M.T.	1	H.T.P.	Kerosene	—	800	—	A.T.	39.0	4.25	32
Gamma Mk. 201	M.P.	4	H.T.P.	Kerosene	H.T.P.	19,000	Turbo-pumps	A.T.	38.0	36.0	700
Stentor BSSt.1	M.P.	2	H.T.P.	Kerosene	H.T.P.	N.A.	Turbo-pumps	A.T.	N.A.	N.A.	N.A.
de Havilland Engine Co., Ltd.											
Spectre D.Spe.5	A.F.	1	H.T.P.	Kerosene	H.T.P.	8,000	Turbo-pumps	A.T.	56.5	24.0	431
Spectre D.Spe.4	A.T.O.	1	H.T.P.	Kerosene	H.T.P.	8,000	Turbo-pumps	N.A.	59.2	21.5	1,393
Double Spectre D.Spe.D.1	A.F./M.P.	2	H.T.P.	Kerosene	H.T.P.	16,000	Turbo-pumps	A.T.	58.6	36.6	N.A.
D. Napier and Son, Ltd.											
Triple Scorpion	A.F./M.P.	3	H.T.P.	Kerosene	H.T.P.	7,000-9,000	Turbo-pumps	A.T.	35.0	21.5	295
Double Scorpion	A.F./M.P.	2	H.T.P.	Kerosene	H.T.P.	4,000-6,000	Turbo-pumps	A.T.	35.0	23.0	216.4
Single Scorpion	A.F./M.P.	1	H.T.P.	Kerosene	H.T.P.	2,000-3,000	Turbo-pumps	A.T.	35.0	16.5	140

Abbreviations.—A.F., Aircraft flight rocket engine; A.T., according to tank capacity; A.T.O., assisted take-off unit; H.T.P., high-test hydrogen peroxide; M.P., missile powerplant; M.T., missile trimmer engine; N.A., not available; *, chamber only.

Ramjets

Make and name	Duty	Fuel	Performance: Thrust	Speed	Height	Consumption	Dimensions: Length	Diameter	Dry weight
Bristol Siddeley Engines, Ltd.			lb.		ft.		in.	in.	lb.
Thor BT.2 (in Bristol/Ferranti Bloodhound)	M.P.	Kerosene	*16,500*	M=3	S.L.	N.A.	91.5	15.75	N.A.
BSRJ.824	M.P.	Kerosene	N.A.	N.A.	N.A.	N.A.	N.A.	18.0	N.A.

Abbreviations.—A.F., Aircraft flight ramjet engine; M.P., Missile powerplant; N.A., not available; S.L., Sea level. Data in italics are estimated.

Missiles and Research Vehicles

Missile Prime Contractor and Name	Type	Status	Powerplant	Guidance	Length	Weight	Speed	Max. range
					ft. in.	lb.	Mach No.	miles
Armstrong Whitworth Seaslug Mk. 1	SAM	Prod.	1×I.C.I. (S.P.); 4 S.P. wrapped boosters	B–R. (G.E.C.)	19 8	N.A.	N.A.	N.A.
Avro Blue Steel	ASM	Dev.	1 Bristol Siddeley Stentor BSSt. 1 rocket engine (L.P.)	In. (Elliott)	35 0	*15,000*	*1.6*	*100+*
Bristol/Ferranti Bloodhound Mk. 1	SAM	Opl.	2×Bristol Siddeley Thor (Rj); 4×S.P. wrapped boosters.	Semi-active homing (Ferranti)	25 0	N.A.	N.A.	N.A.
de Havilland Propellers Blue Streak	?	Dev.	1×two-chamber Rolls-Royce rocket engine (L.P.)		70 0	*200,000*	N.A.	*2,500 n.m.*
de Havilland Propellers Firestreak Mk. 1	AAM	Opl.	S.P.	I–R.	10 5½	300	2.0+	4+
de Havilland Propellers Red Top	AAM	Dev.	N.A.	I–R.	N.A.	N.A.	N.A.	8
English Electric Blue Water	SSM	Dev.	S.P.	In.	N.A.	N.A.	N.A.	N.A.
English Electric Thunderbird Mk. 1	SAM	Opl.	1×S.P.; 4×S.P. wrapped boosters	Semi-active homing (Marconi)	20 8	N.A.	N.A.	N.A.
Malkara. (Australian Government Aircraft Factories)	Anti-tank	Prod.	2-st. S.P.	Wire Cd.	6 3½	206	N.A.	2
Pye Python	Anti-tank	Dev.	2-st. Bristol-Aerojet (S.P.)	Wire Cd.	5 0	80	N.A.	N.A.
Saunders-Roe Black Knight (re-entry research vehicle)		Prod.	1×16,400 lb.s.t. B.S. Gamma	Elem. pitch programmer	35 0	N.A.	N.A.	500 alt.
S.R. Black Knight (two-stage)		Prod.	1×16,400 lb.s.t. B.S. Gamma+1×S.P.	Elem. pitch programmer	N.A.	N.A.	N.A.	1,000–1,500 alt.
Skylark (upper-air research vehicle)		Prod.	1×12,000 lb.s.t. Raven (S.P.)+optional 20,000 lb.s.t. Cuckoo booster	None	25 0 (no booster)	2,560 (no booster)	5.0	100–180 alt.
Short Seacat	SAM	Dev.	2-st. S.P.	Radio Cd.	*4 10*	N.A.	N.A.	N.A.
Vickers Vigilant	Anti-tank	Dev.	2-st. I.C.I. (S.P.)	Wire Cd.	1 11½	26	*350 m.p.h.*	?

Abbreviations.—B–R., beam-riding; Cd., command; Dev., under development; In., inertial; I–R., infra-red; L.P., liquid-propellent; N.A., not available; Opl., operational; Prod., in production, not yet opl.; Rj., ram-jet; S.P., solid propellent; st., stage; s.t., static thrust. Data in italics are estimated or approximate.

converts

fighter to tanker

in 60 minutes

THE Mk 20 refuelling pack

GIVE GENEROUSLY R.A.F. BENEVOLENT FUND 67 PORTLAND PLACE LONDON, W.1.

Tuck a Mk 20 Refuelling Pack under the wing of a single-seat fighter and it becomes a high-ceiling, high-speed aerial tanker. With the refuelling pack, Probe and Drogue in-flight refuelling is possible 40,000 ft. (12,200 metres) up, at 300 knots (566 k.p.h.) indicated, and at the rate of 150 gallons per minute (680 litres per minute).

In just 60 minutes this compact self-powered ram-air turbine driven unit weighing only 800 lb dry weight (363 kgs) can be fitted to standard underwing pylons of fighter and strike aircraft. Removal of the store is even quicker. The refuelling pack's own capacity is 150 gallons (680 litres) but it can transfer as much fuel as the aircraft can carry. It speaks for the simplicity of the controls that the unit can be operated safely from a single-seat aircraft. The refuelling pack is built by Flight Refuelling Limited, the pioneers of the Probe and Drogue in-flight refuelling system.

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Flight Refuelling Ltd

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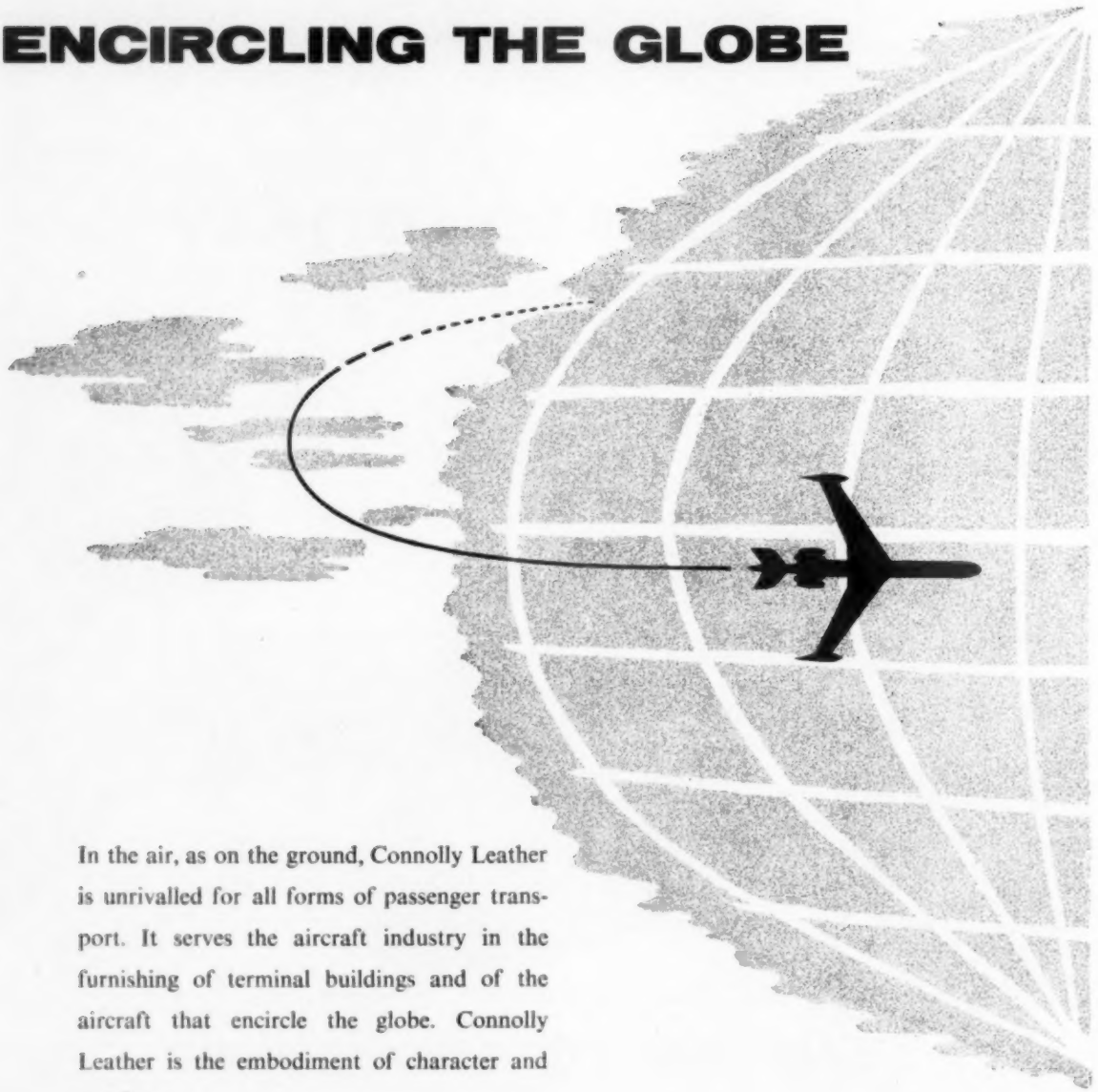
ENCIRCLING THE GLOBE



In the air, as on the ground, Connolly Leather is unrivalled for all forms of passenger transport. It serves the aircraft industry in the furnishing of terminal buildings and of the aircraft that encircle the globe. Connolly Leather is the embodiment of character and comfort.

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ON SHOW AT FARNBOROUGH

A Guide to the Indoor and Outside Stands

On this and the following 15 pages will be found a guide to the exhibits on the stands in the static exhibitions at Farnborough. The exhibitors are listed alphabetically with their stand numbers; the initials O.D.S. indicate the outside display sites, and R.D.S. the radar demonstration sites. A six-page directory of non-exhibitors follows this section.

MAJOR EXHIBITS

Aircraft

Armstrong Whitworth Argosy; Auster D.4/108 and D.6/180; Avro Vulcan B.2; Avro 748; Blackburn N.A.39; Bristol Britannia 253; de Havilland Sea Vixen; de Havilland Dove 8; de Havilland Leonides Beaver; de Havilland Heron; de Havilland Misrair Comet 4C; English Electric Lightning F.1 and T.4; Folland Gnat Trainer; Gloster Javelin FAW.9; Handley Page Victor B.2; Handley Page Herald; Hawker Hunter 66A and FR.10; Hunting Jet Provost T.3 and T.4; Lancashire Aircraft Prospector Series 2; Napier Lincoln (de-icing); Scottish Aviation Twin Pioneer 3; Short S.C.1; Vickers Vanguard 952 (T.C.A.); Westland Westminster; Westland Gnome Whirlwind and 10; Westland Wessex 1; Westland Turmo Skeeter; Westland Gnome Wasp; Westland P.531/2; Westland Belvedere; Westland Rotodyne.

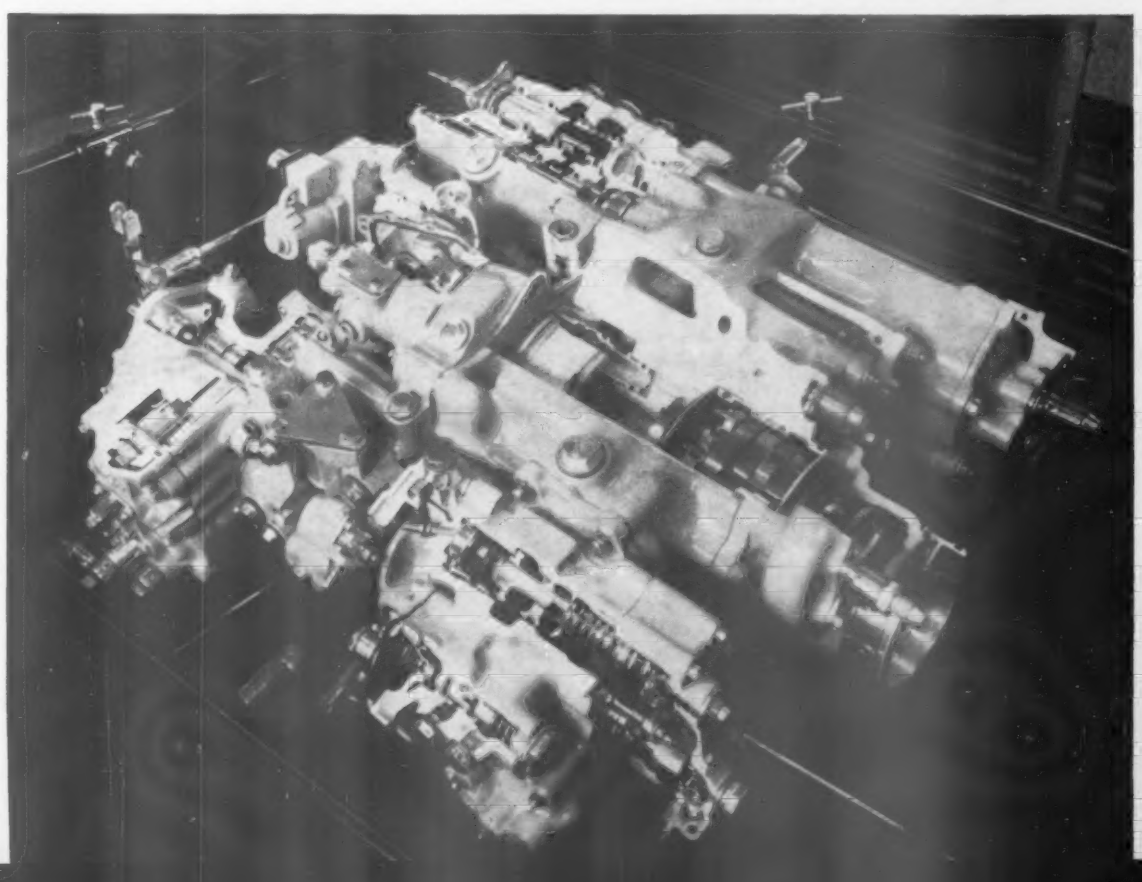
Powerplants

Alvis Leonides Major series 750 helicopter engine; Alvis Leonides 531; Alvis Leonides 554 helicopter engine; Blackburn Nimbus (A.129); Blackburn Turmo 600; Bristol Siddeley BS.53 lift/thrust ducted fan; Bristol Siddeley Stentor; Bristol Siddeley BSRJ-824; Bristol Siddeley Olympus 21; Bristol Siddeley Olympus with reheat; Bristol Siddeley Orpheus 803; Bristol Siddeley Viper 11; Bristol Siddeley Gamma; Bristol Siddeley Proteus; de Havilland Gnome H.1000; de Havilland coupled Gnome H.1200; de Havilland Gnome P.1000; de Havilland Gipsy Major 215; de Havilland Gyron Junior DGJ.2; de Havilland Gyron Junior DGJ.10; de Havilland Double Spectre D.Spe.D1; Napier Gazelle; Napier single-barrel Scorpion rocket engine; Rolls-Royce RB.141; Rolls-Royce Conway; Rolls-Royce Avon RA.29; Rolls-Royce Avon RB.146; Rolls-Royce Tyne; Rolls-Royce RB.108; Rolls-Royce Dart RDa.10.

Missiles

Armstrong Whitworth Seaslug; Avro Blue Steel; Bristol/Ferranti Bloodhound; de Havilland Firestreak; English Electric Thunderbird; (Fairey) Malkara anti-tank missile; (Fairey) Jindivik target drone; M.o.A. Black Knight second stage; Short Seacat.

A sectioned Dowty fuel system for the de Havilland Gyron Junior DGJ.2 turbojet in production for the Blackburn N.A.39.



Guide to the Static Displays . . . .

Accles and Pollock, Ltd. (138). New forms of flexible and semi-flexible tubing are on display including fine pitch and re-entrant types, with and without plain ends to take various types of fitting. Honed and machined tubes for undercarriages and other hydraulic applications are also exhibited together with a range of light gauge duct tubing in Nimonic material.

Acton Bolt, Ltd. (118). A range of aircraft bolts and screws to standard specifications, together with a display of tools used in the manufacture of cold headed upset high tensile bolts.

Aero Controls, Ltd. (29). The major part of this exhibit consists of the company's A.R.B.-approved A.C. Flex couplings for pipe lines. Acflex Flightweight flexible couplings for rigid pipe lines are also displayed.

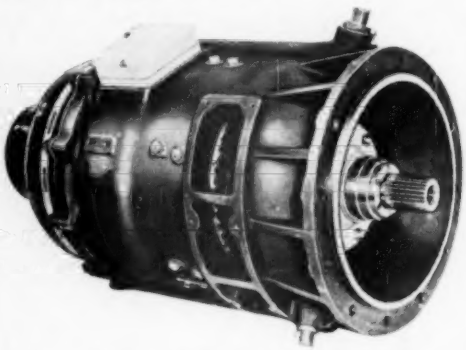
Aircraft Furnishing, Ltd. (280). On display is the full range of Lonsdale aircraft passenger seating comprising double and triple versions of the Flyweight economy class seats, tourist class seating, new first class and luxury seats, and new cabin lounge seating.

The Type 200 triple aircraft seat produced by Aircraft Furnishing, Ltd.

Aircraft Materials, Ltd. (252). Products include the Pop and Imex ranges of rivets; parachute, ejector-seat and helicopter rescue-harness fittings; supply dropping equipment including de-reefing devices.

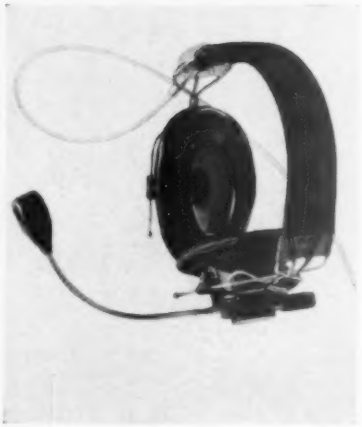
Airmed, Ltd. (268). On show are the latest items in the company's range of lightweight telecommunication headsets for aircraft to ground communication and ground control of air traffic, together with instant positioning emergency oxygen breathing masks for civil aircraft and masks for high altitude Service aircraft. On display for the first time is a new microphone boom for use with a protective crash helmet.

The Airscrew Co. and Jicwood, Ltd. (181). The centre piece of this display is a full scale working model of a Comet 4 wheel manufactured by Dunlop and fitted with an Airscrew four-bladed axial-flow impeller. A wide range of centrifugal and axial-flow fans for ground and airborne equipment cooling, cabin ventilation and heating, oil cooling and windscreen de-icing is also exhibited.



Left, The Associated Electrical Industries self-excited, brushless, constant-speed alternator, providing 40 kVA at 6,000 r.p.m.

Airtech, Ltd. (O.D.S. R). Exhibits include the Aircon types D and E transportation containers; a UHF pack set; a cloud base recorder; Tubelock polythene tube fittings; and electronic equipment.



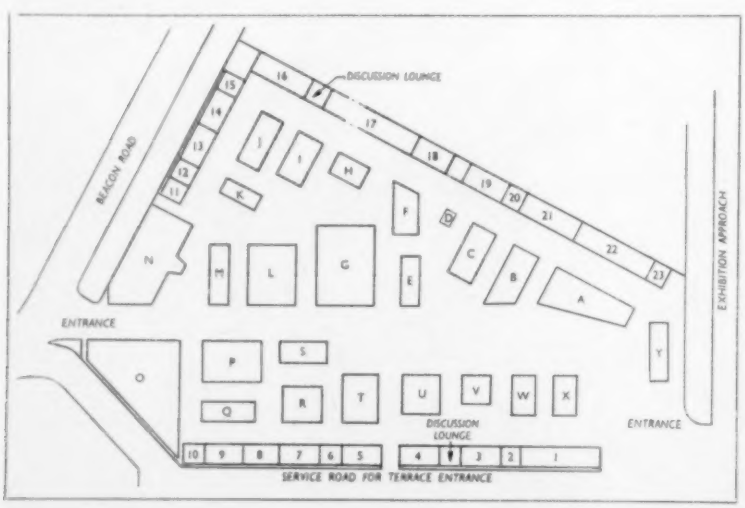
A new lightweight headset produced by Amplivox. It has an "all position" boom arm with a choice of magnetic, noise cancelling or carbon microphones.

Albright and Wilson, Ltd. (266). Manufacturers of Kanigen plate, a chemical nickel-phosphorus plating process.

(*Continued on page 317*)

OUTDOOR DISPLAY SITES

Company	*Stand No.*
Airtech, Ltd.	R
Auto Diesels, Ltd.	2 and W
Automotive Products Co., Ltd.	V
Blackburn Engines, Ltd.	6 and T
The British Oxygen Co., Ltd.	G
Brown Brothers (Aircraft), Ltd.	5
A.C. Cossor, Ltd.	8
Delaney Gallay, Ltd.	9
Dexion, Ltd.	22 and A
H. W. Edghill and Co., Ltd.	15 and J
Ekco Electronics, Ltd.	20 and C
P. Frankenstein and Sons (Manchester), Ltd.	F
Gloster Aircraft Co., Ltd.	10 and Q
Sir George Godfrey and Partners, Ltd.	7
H.M.L. (Engineering), Ltd.	1 and X
Houchin, Ltd.	23 and Y
Kelvin and Hughes (Aviation), Ltd.	16
The Walter Kidde Co., Ltd.	F
Lancashire Aircraft Co., Ltd.	11 and N
Laporte Chemicals, Ltd.	18
J. Lucas (G.T.E.), Ltd. / Lucas-Rotax, Ltd.	21 and B
M.L. Aviation Co., Ltd.	P
Marconi Instruments, Ltd.	M
Microcell, Ltd.	17
Ministry of Aviation	3
Morfax, Ltd.	4 and U
Pye Telecommunications, Ltd.	12
The Pyrene Co., Ltd.	E
Rellumit (London), Ltd.	H
Rotax, Ltd.	21 and B
Rover Gas Turbines, Ltd.	19 and D
Short Bros. and Harland, Ltd.	L
Simmonds Aerocessories, Ltd.	S
Tecalemit, Ltd.	K
Truro Engine Works, Ltd.	1
Vernons Industries, Ltd.	13
W. Vinten, Ltd.	14
Zwicky, Ltd.	O



0745
Into the sixties with
AIR BP

Into the sixties with
AIR BP

AIR BP leads . . .
in minimising time
on the ground

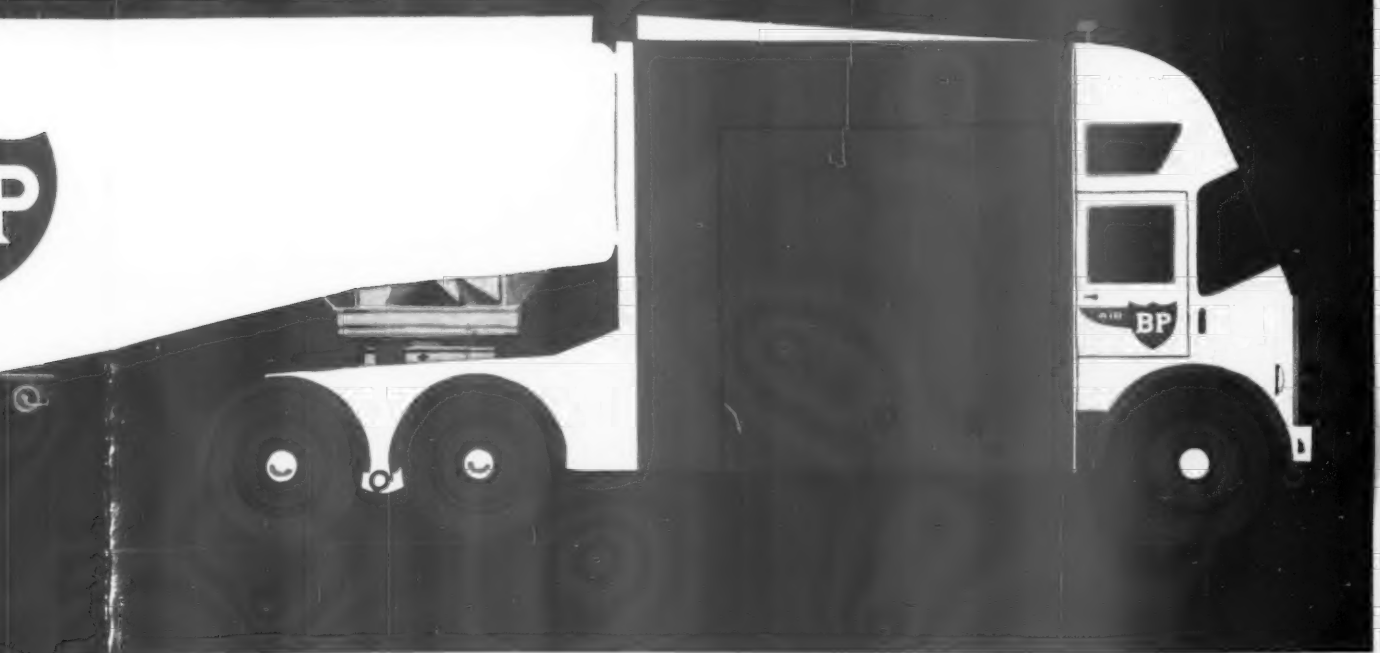
With the jetliners in world-wide service, the pace of air travel and airport management has been transformed. New "maximum utilisation" schedules demand elimination of the wasted minute. AIR BP matches new fuelling equipment and methods against the vast capacity and consumption of the new airliners.

AIR BP leads . . .
in fuel cleanliness

The jets bring other problems. Fuel impurities cause troubles unknown to the piston engine. Water in fuel forms ice at the new operating altitudes. Years of anticipatory work on these problems by AIR BP have established new, highest-ever standards for cleanliness of fuel delivered.

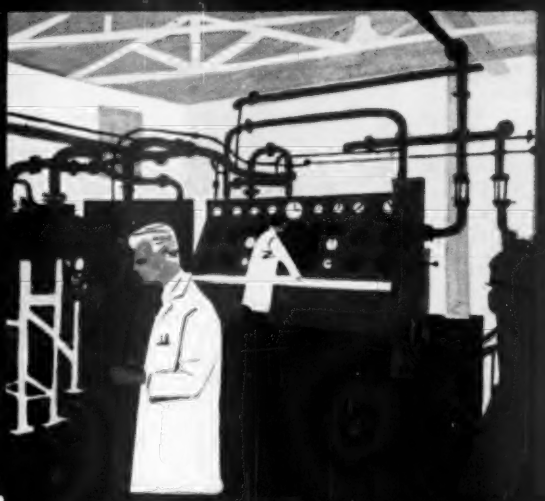
AIR BP leads . . .
in product research

Future aircraft will bring new technical problems in the fuel field. Foreseeing the effects of kinetic heating and of even lower temperatures to be met in flight, AIR BP research studies the needs of aircraft on, and not yet on, the drawing board: establishing that AIR BP fuels will give no trouble in the "heat barrier" at the highest foreseeable temperatures — and at the lowest will not form pump-clogging slush.



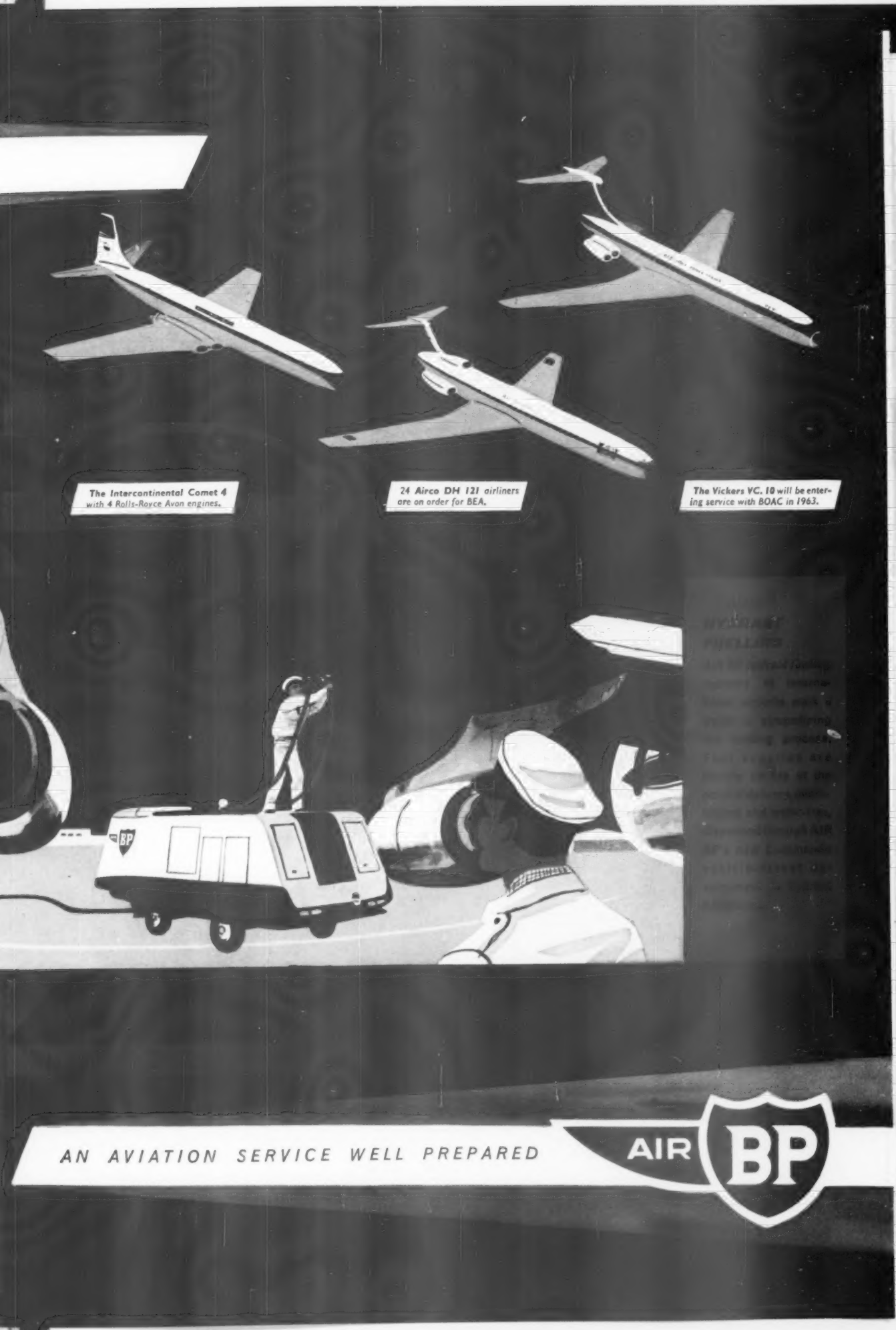
10,000-gallon AIR BP SUPERFUELLER in service in 1960

INTO THE SIXTIES...



At the crossroads of the world air map, the international airports of many nations, AIR BP services the aircraft of a growing number of airline operators.

The ground organisation of AIR BP is a highly integrated machine, designed for and geared to the ever-tightening schedules of air transportation, unobtrusive in action, swift in execution, accurate in anticipation.


The Intercontinental Comet 4 with 4 Rolls-Royce Avon engines.
24 Airco DH 121 airliners are on order for BEA.
The Vickers VC. 10 will be entering service with BOAC in 1963.
BP
AN AVIATION SERVICE WELL PREPARED
AIR BP

AIR BP leads . . . in minimising time on the ground

With the jetliners in world-wide service, the pace of air travel and airport management has been transformed. New "maximum utilisation" schedules demand elimination of the wasted minute. AIR BP matches new fuelling equipment and methods against the vast capacity and consumption of the new airliners.

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The jets bring other problems. Fuel impurities cause troubles unknown to the piston engine. Water in fuel forms ice at the new operating altitudes. Years of anticipatory work on these problems by AIR BP have established new, highest-ever standards for cleanliness of fuel delivered.

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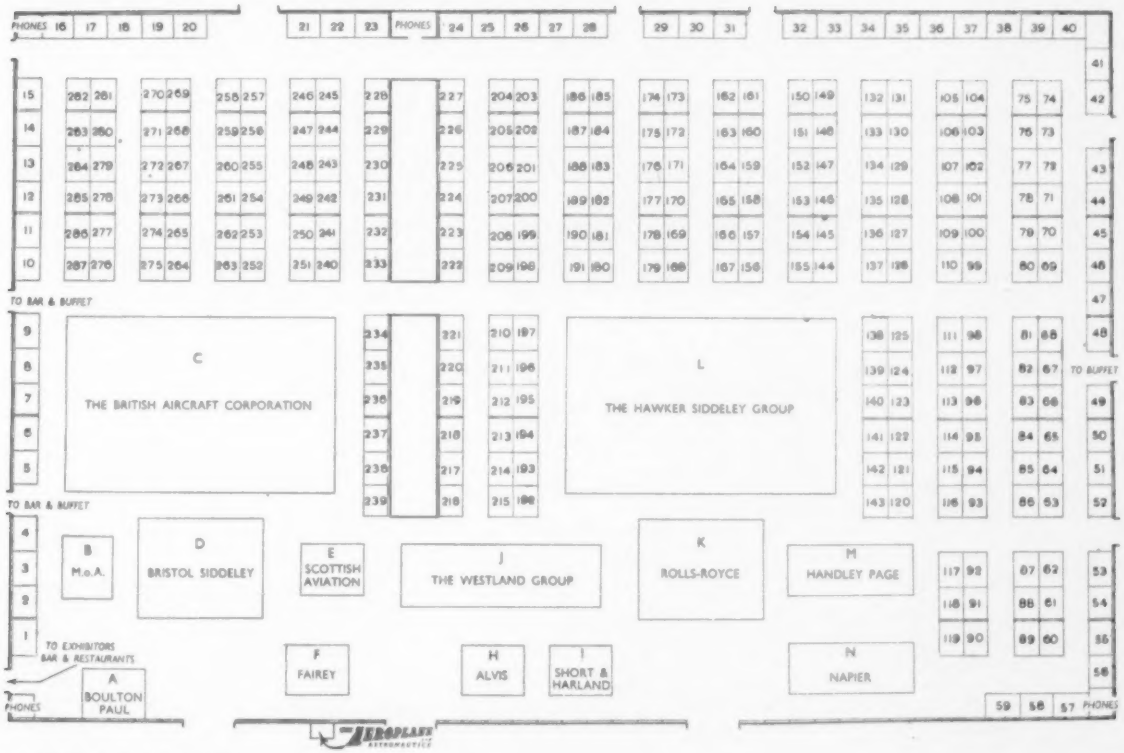
Future aircraft will bring new technical problems in the fuel field. Foreseeing the effects of kinetic heating and of even lower temperatures to be met in flight, AIR BP research studies the needs of aircraft on, and not yet on, the drawing board: establishing that AIR BP fuels will give no trouble in the "heat barrier" at the highest foreseeable temperatures — and at the lowest will not form pump-clogging slush.

10,000-gallon AIR BP SUPERFUELLER in service in 1960

Guide to the Static Displays . . . .



PRINCIPAL EXHIBITORS

Company	*Stand No.*	*Company*	*Stand No.*	*Company*	*Stand No.*
Alvis, Ltd.	H	Handley Page, Ltd.	M	Rolls-Royce, Ltd.	K
Boulton Paul Aircraft, Ltd.	A	The Hawker Siddeley Group	L	Scottish Aviation, Ltd.	E
Bristol Siddeley Engines, Ltd.	D	Ministry of Aviation	B and 3	Short Bros. and Harland, Ltd.	I
The British Aircraft Corporation	C	D. Napier and Son, Ltd.	N	The Westland Group	J
Fairey Engineering, Ltd.	F				

(*Continued from page 316*)

Alvis, Ltd. (H). A range of piston engines for aircraft and helicopters including the 750 Series Leonides Major and the Leonides 554 nine-cylinder long-stroke helicopter engine.

Amplivox, Ltd. (163). New exhibits on show for the first time include two lightweight headsets, hand microphones and a tropical earphone for partial pressure helmets. Other headphones, headsets and ear defenders are also on the stand.

Associated Electrical Industries, Ltd. (178 and 196.) A diagrammatic layout shows the principal components of a DC power system; a similar layout illustrates those of an AC power system. Both layouts include all the equipment required in a single generating channel up to the main busbars. Associated with each power system layout are examples of DC and AC equipment and components suitable for use in either type of system, including small toggle switches new circuit-breakers and silicon semi-conductor devices. The target tracking and illuminating radars used with Bloodhound and Thunderbird SAMs are also on show.

Auster Aircraft, Ltd. (287). Information relating to the company's new "D" series aircraft, in particular, the four-seat D.6.

Auto Diesels, Ltd. (O.D.S. 2 and W). Aircraft starting and servicing equipment on show comprises a dual voltage DC ground power unit; a 60 kVA 400 c.p.s. AC servicing unit; and the Aydec gas turbine air starter.

Automotive Products Co., Ltd. (49 and O.D.S. V), and **Lockheed Precision Products, Ltd.** (50). The main feature on the combined indoor stands is Lockheed aircraft equipment fitted to the de Havilland 121, the Folland Gnat Trainer, the Avro 748 and the Vickers V.C.10. Outside there is a full range of Purolator bulk filters and filter/separators for aircraft refuelling. There is also a working demonstration of this filter/separator for vehicle mounting and static installations.

Avery-Hardoll, Ltd. (186). Products cover aviation fuelling equipment including bulk-meters, refuellers and hydrant dispensers; quick release self-sealing couplings; and automatic bottom loading units.

Aviation Developments, Ltd. (237). Items on display include the Jo-Bolt high-strength fastener; the Avlok blind anchor nut; the Chobert rivet; the Huckbolt high-speed bolting system; and the Avdel self-sealing blind rivet.

Avica Equipment, Ltd. (246). New work in the field of a high temperature (500°C.) flange/clamp/seal joint for air duct systems; developments in derivatives of Flexflyte including special shapes and a new lay-flat air starter duct; an H.T. series of all-stainless-steel support clips; gimbal-type flexible joints for air ducting systems in sizes; and other piping and ducting components.

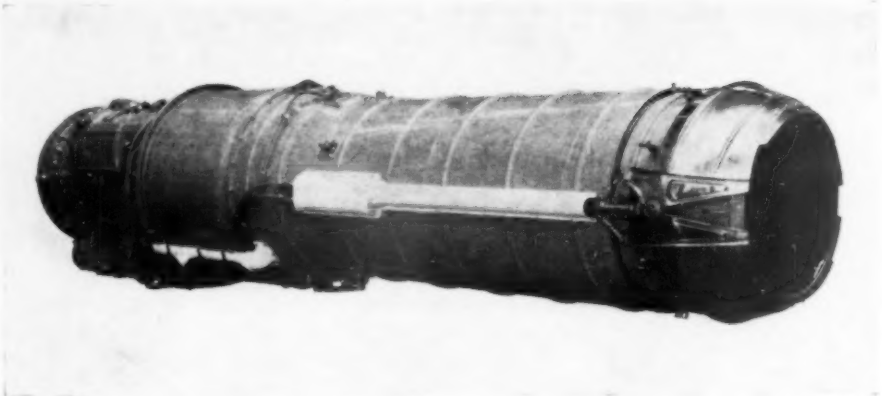
Bakelite, Ltd. (282). A resin section of the stand features a selection of components from those currently fabricated in Bakelite polyester resin by leading aircraft manufacturers. Another section is devoted mainly to showing the uses of printed circuits based on copper-clad Bakelite laminate. Tools and construction jigs made from laminated and densified wood are also featured.

Baxter, Woodhouse and Taylor, Ltd. (152) A new type of flexible air ducting which has the special properties of considerable sound attenuation and light weight; wall panel, air ducting and insulation in preformed shaped, moisture-resistant bags; and aircrew pressure helmets and their associated test equipment, including a special N_2 Nitrometer.

B.B. Chemical Co., Ltd. (158). This stand covers the diverse range of Bostik products used by the aircraft industry. Details are available on the specialized range of Bostik sealants that are used for the pressurization of cabins and for the sealing of integral fuel tanks.

An aircrew pressure helmet manufactured by Baxter, Woodhouse and Taylor.

Guide to the Static Displays . . . .



The latest development in the Bristol Siddeley Orpheus family of lightweight, medium thrust turbojets is this B.Or. 12 which develops a dry thrust of 6,810 lb. With reheat and a variable area nozzle, this can be increased by some 20% to 8,170 lb.

Bell Precision Engineering Co., Ltd. (189). Special tools for the aircraft industry.

Bell's Asbestos and Engineering, Ltd. (65). Exhibits include numerous improved versions of established products which incorporate recently introduced synthetic materials, such as Viton "A" and "B" and P.T.F.E. These cover fire seals; garter spring seals; flexible hoses; Bestobell collapsible air-starting hose; and connecting sleeves.

Belling and Lee, Ltd. (105). On show are two new types of connector, the Camlok and the Autolock, in which every pin of the plug is individually locked into its mating socket; a range of fully sealed B.N.C. plugs and sockets; and connectors for flat ribbon supply feeder cables.

Birmetals, Ltd. (99). Examples of aircraft sheet and strip together with a typical range of extruded sections suitable for use by the aircraft industry in all D.T.D. specifications.

Birmingham Aluminium Casting (1903) Co., Ltd. (140). Castings by the sand, gravity die, and pressure die processes in aluminium and magnesium alloys to B.S. specifications, including the latest magnesium-zirconium-thorium alloys.

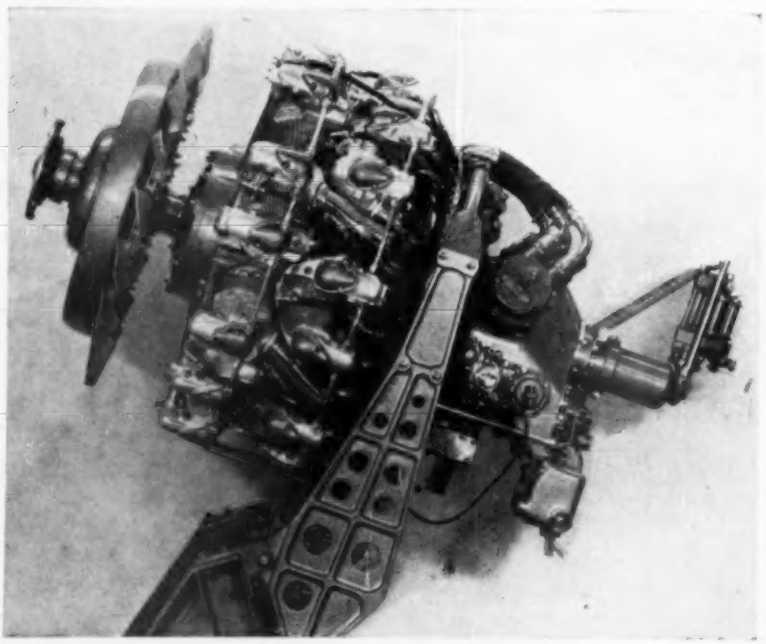
Blackburn Engines, Ltd. (O.D.S. 6 and T). The Palouste low-pressure air starter in trolley and pod forms; a Turmo emergency airfield lighting set; and a sectioned Palas gas generator.

James Booth Aluminium, Ltd. (218). The main exhibit is a display of extruded sections, plate, sheet, tubes and large forgings for the aircraft industry, in the company's Duralumin and other aluminium alloys. This is supported by photo transparencies of some of the aircraft in which the company's alloys are used.

Boulton Paul Aircraft, Ltd. (A). Exhibits are mainly concentrated on the electro-mechanical aspects of aircraft control and examples of possible configurations of VTOL aircraft. Items include powered flying control units for the Vickers VC10, models and electronic test equipment.

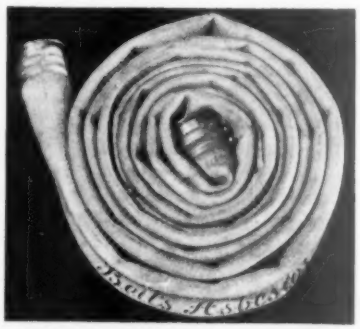
B.P. Trading, Ltd. (210). The company's exhibit features B.P.-Shell service to aviation.

Brent Chemical Products, Ltd. (265). Exhibits on this stand cover crack detection processes, paint removers, engine cleaning compounds and electrical cleaning compounds.



A 14-cylinder, two-row, medium supercharged Alvis Leonides Major 750 Series helicopter engine.

Bristol Aerojet, Ltd. (187). On this stand there is a recoverable-payload flight test vehicle; two exhibits illustrating the company's techniques of making thin-wall tubes by helical welding, and of making lightweight stiff structures; a reinforced plastic sphere for radar work; and high pressure gas storage vessels.



Bestobell silicone Terylene collapsible air-starting hose produced by Bell's Asbestos and Engineering.

Bristol Aeroplane Plastics, Ltd. (238). A wide range of aviation equipment and components in reinforced plastic materials, including a reinforced plastic life-raft container developed by the company for use on aircraft or in air/sea rescue operations; three examples of the company's range of asbestos-phenolic drop fuel tanks; a quarter-scale model of a drop tank; a model of a fluted core radome; and a nose cone for the Bristol-Ferranti Bloodhound.

Bristol Siddeley Engines, Ltd. (D and 239). New engines on these stands are the BS 53 lift/thrust ducted fan turbojet; the Stentor rocket engine; and the BSRJ-824 ramjet. Olympus, Orpheus B.Or. 12 and Viper 11 turbojet engines; Proteus 765 turboprop; Gamma rocket engine; recirculating ball screws and ball splines; and gas-bearing circulators and pumps are also exhibited.

British Aircraft Corporation, Ltd. (C). A combined stand with each of the four subsidiary companies occupying a quarter. Vickers are exhibiting models of the Super VC10, and Super VC10 freighter system, Vanguard and Viscount. English Electric have a full scale Thunderbird SAM, an animated display demonstrating the mobility of the Thunderbird system, and Lightning and Canberra models. Bristol Aircraft's exhibit includes a sectioned model of a Bloodhound and electronic equipment developed for guided weapons test and research programmes. Models of the Jet Provost and the B.A.C. 107 project are displayed by Hunting Aircraft.

(*Continued on page 319*)

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***PLANNAIR blowers** in the VC 10*

Performance plus quietness! That's what Vickers demanded of the blower for air re-circulation in the passenger cabin of the VC10. They called in Plannair. The result—a Cabin Air Re-circulation Blower with special impeller blades and sound deadening features which together provide a quite remarkable degree of comfort for the passengers. Whenever the problem is to provide the right amount of air in the right place, in the right way, follow Vickers' example and call in Plannair. You'll never buy a better blower!

Plannair elsewhere in the VC 10
Other Plannair Blowers in this impressive aircraft will be installed for Smoke Detection, Galley Ventilation, Radio Rack Cooling and Louvre Boost to Cabin.

See **STAND 224** at the **S.B.A.C. Exhibition**

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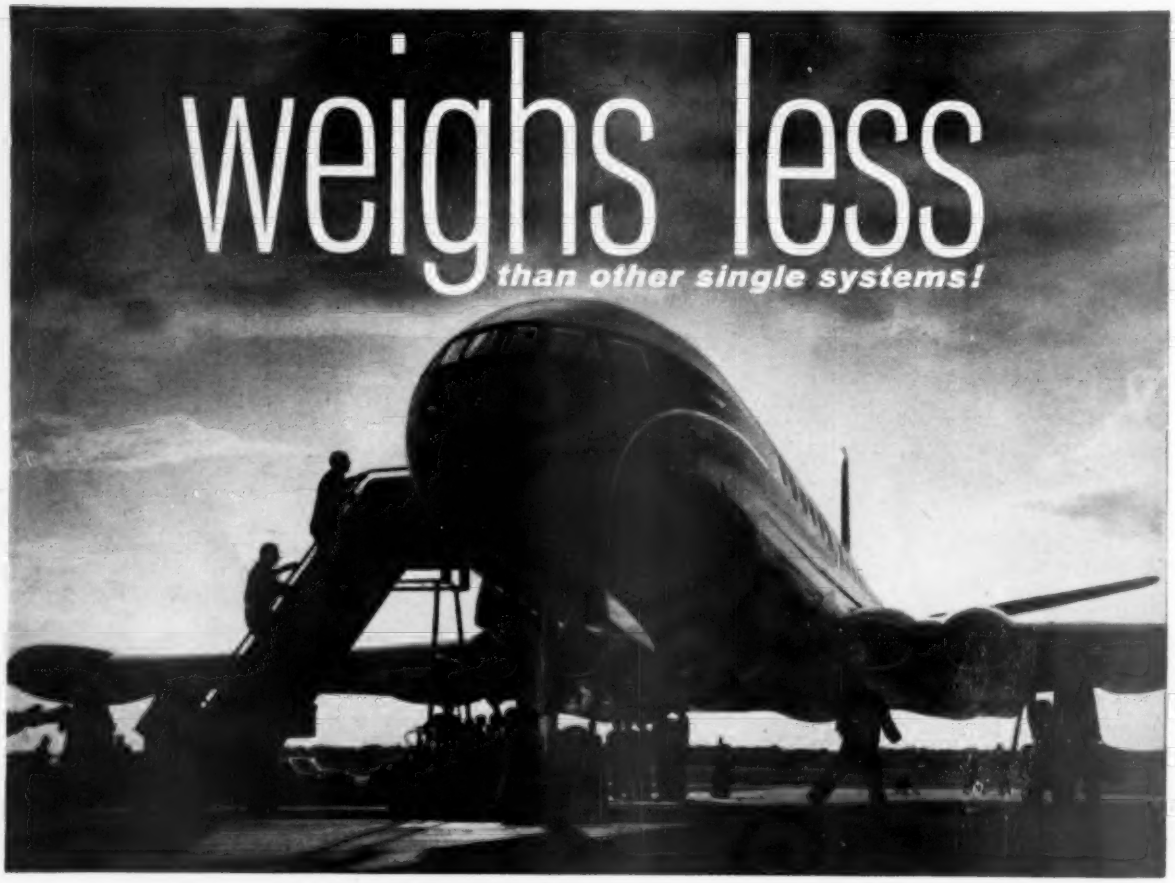
PLANNAIR LIMITED

WINDFIELD HOUSE · LEATHERHEAD · SURREY · TELEPHONE: LEATHERHEAD 4091/3

PLA 81

EKCO duplicate system lightweight weather radar



Weather Radar, already mandatory in some areas, will become essential equipment in many types of aircraft. A duplicate system is the obvious way to guard against the possibility of grounding due to equipment failure.

Now, aircraft can be fitted with a duplicate system involving a total weight of only 103 lbs—yet providing maximum performance and operational efficiency.

Ekco Lightweight Weather Radar makes this possible by the extensive use of transistors. The Ekco duplicate system employs two Transmitter/Receivers, two Indicators, a Scanner and Junction Box—and weighs less than competitive single systems! It not only saves space and weight but also reduces total power consumption to less than half that required by 60 kW systems.

See Ekco Duplicate System Lightweight Weather Radar at the S.B.A.C. Farnborough Exhibition together with Automatic VHF/DF Equipment; Airfield Approach Aids; Transistorised Inverters.

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WPS 334

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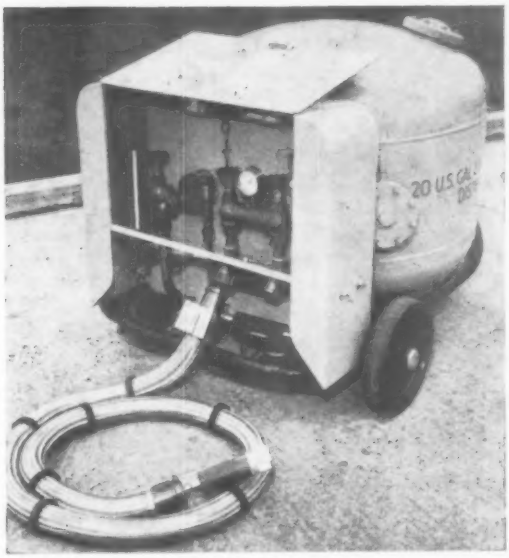


Left, the British Oxygen Company's 20-gallon mobile dispenser for liquid oxygen.

Below, the Brown Brothers (Aircraft) 40-ton hydraulic Rotheswan Aerojack.

(*Continued from page 318*)

The British Aluminium Co., Ltd. (219). Products cover aluminium and aluminium alloys in all standard wrought forms and heat-treated aluminium sheet.

British Communications Corporation, Ltd. (130). Activities include the development of communications and magnetic recording equipment and electronic measuring apparatus; VHF ground equipment; flight deck broadcasting systems.

British Ermeto Corporation, Ltd. (245). Exhibit consists of Ermeto high pressure pipe couplings in mild steel, stainless steel, light alloy and brass, together with high pressure valves in mild steel, stainless steel and bronze. These valves include shut off, control, non-return, check, balance and relief types. Also included is a range of high pressure flexible hoses and a selection of Simplifix compression joints for copper and nylon tube.

British Insulated Callender's Cables, Ltd. (198). Manufacturers of aircraft wiring cables; ignition cables and thermocouple leads; radio frequency cables; cables for airfield lighting; connecting and winding wires; radio capacitors; aluminium wire, sheets and strands.

British Manufactured Bearings Co., Ltd. (44). A range of precision miniature ball races, including high speed bearings for operation up to 300,000 r.p.m.; special bearings for gyroscopic and high temperature applications; steel balls to limits of better than 0.000005 in.; pressurised assembly cabinets.

British Oxygen Aviation Services (200, 202 and O.D.S. G). The largest part of the indoor display is devoted to a comprehensive range of liquid oxygen breathing systems and equipment, with particular emphasis on systems designed for emergency passenger use. Liquid nitrogen fuel tank explosion suppression systems will also be shown. A full range of liquid ground handling equipment for use on airfields is exhibited in the outside display area.

British Paints, Ltd. (78). Exhibit features the use of the company's 1400 Series P.R.C. Sealants which are now coming into general use in the sealing of aircraft integral fuel tanks and pressurized areas. They are all two component polysulphide rubber compounds.

The British Refrasil Co., Ltd. (171). Manufacturers of high-temperature lightweight insulation material in cloth, batt, cleeving, cordage and tape.

Brown Bayley Steels, Ltd. (72). Products cover forged and rough-turned rings; black rolled descaled and bright ground bar; stainless steel sheet in various finishes.

Cossor are demonstrating secondary surveillance radar in their outside display. This SSR4G combined interrogation and control aerial forms part of the company's secondary radar system.

Brown Brothers (Aircraft), Ltd. (193 and O.D.S. 5). Standard A.G.S., B.S. and S.B.A.C. parts; Hi-Shear pins and collars; Oddie stiff nuts; and special machined parts are on the indoor stand. Outside there is the standard range of Rotheswan Aerojacks; nose-wheel jacks and power-operated jacks.

David Brown Industries, Ltd. (80). Producers of all types of gears and gear units; machine tools and castings.

S. G. Brown, Ltd. (225). Outstanding features are the Gyroturin dynamic reference system based on the Master Reference Gyro, and the Helicompass true north seeking gyro compass for use in helicopters. Other exhibits include an Arma-Brown floating gyro, servo motors and other electronic units.

Bryans Aeroquipment, Ltd. (121). Manufacturers of aircraft instrument and component test gear; electrical and electronic laboratory equipment; control and instrument panels.

Burgess Products Co., Ltd. (150). Products include exhaust and cabin blower silencers, air cleaners, aircraft-cabin soundproofing, precision switches for aircraft and ground application, and vibro tools for engraving.

Burndept, Ltd. (61). Manufacture the BE 255 five-channel VHF light-weight airborne transmitter/receiver. Designed to meet the requirements of light aircraft, this equipment has a frequency range of 118–132 Mc/s. and a power output of 1 watt unmodulated.

Cellon, Ltd. (192). Full range of approved aircraft dopes and finishes conforming to A.I.D. and A.R.B. requirements. Latest developments in Cellon cold catalysed resistant finishes for high speed aircraft and guided missiles; also special resistant finishes for crop spraying aircraft. Cellon water resistant primers, heat resistant paints, chemical contouring materials, sealant for magnesium protection and Celloseel jointing compound; also fluorescent colours for recognition and anti-collision requirements.

Cementation (Muffelite), Ltd. (127). Range of Barrymount anti-vibration isolators and shock mounts for the protection of airborne equipment, together with illustrations and details of the environmental test facilities available to industry at the company's laboratories at Hersham, Surrey, which are fully approved by the M.o.A. and A.R.B. Information on the project development work undertaken on isolation systems, including special contract testing investigations.

Chelton (Electrostatics), Ltd. (159). Exhibits comprise a comprehensive range of aircraft aerial masts, tension units and associated equipment, together with typical aerial arrays. New items include plastic-coated whip aerials, two-stage weak link tension units, development of Midget static discharger and ADF arrays.

The Chesterfield Tube Co., Ltd. (273). Products include seamless steel and light-alloy gas cylinders for airborne and ground installations; precision seamless steel rocket-motor tubes; extrusions in ferrous and rare metals; beryllium tubes and rods; alloy-steel undercarriage tubes.

J. S. Chinn and Co., Ltd. (170). A display of aircraft and engine components and assemblies fabricated from titanium, Nimonic stainless steel, aluminium and magnesium alloys.

Chloride Batteries, Ltd. (236). Among the representative selection of batteries from the Exide range are new dry units developed for transistorized equipment; 24V. batteries for civil and military aircraft; and portable units for use in the guided weapons and electronics fields.

The Arma-Brown true north seeking gyro compass which can be used in helicopters.

Guide to the Static Displays . . . .

CIBA (A.R.L.), Ltd. (103). The most striking exhibit on this stand is a 12 ft. 6 in. long rudder panel from the Vickers Vanguard illustrating a typical use of Aeroweb honeycomb core in aircraft structures. Redux and Hidux bonding is featured and examples of bonded components from several different aircraft are also on display, together with Araldite epoxy resins.

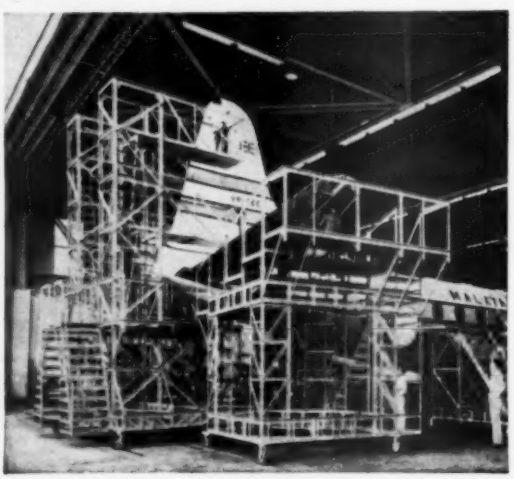
E. K. Cole, Ltd. (96). The latest range of Ekco transistor inverters, including single- and three-phase units.

Connolly Bros. (Curriers), Ltd. (228) Leather for upholstery and panelling and general furnishing of aircraft and for furniture and decoration of airports and terminal buildings.

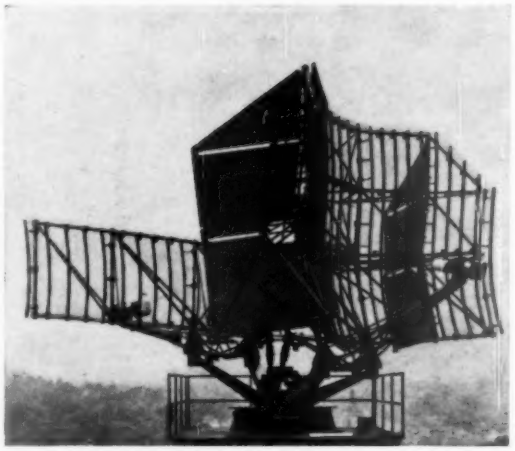
Coopers Mechanical Joints, Ltd. (45). Exhibits include fuel and lubricating oil strainers; gaskets in copper and asbestos and steel; corrugated gaskets for high temperature sealing in stainless steel and nimonic steel; shims in various metals including laminated brass and laminated aluminium; washers in folded copper, steel and copper and asbestos; and cork and synthetic rubber materials.

A. C. Cossor, Ltd., and **Cossor Radar and Electronics, Ltd.** (254, 255, O.D.S. 8 and R.D.S.). Exhibits include a new windfinding radar system with control desk; a secondary radar demonstration comprising aerial, interrogator/responder coupled to installation CRD.23; automatic data link; and a rack for civil and military transponders.

de Havilland Propellers have developed this automatic check-out and recording equipment for the testing of aircraft, missile and ground equipment systems.



A Malayan Airways Viscount being serviced with the aid of this tail maintenance platform constructed from Dexion slotted angle.



The aerial system of the Decca D.A.S.R.–1 surveillance radar. The two reflectors produce separate overlapping high and low cover beams which together make up the composite gap-free coverage of the system.

John Curran, Ltd. (203). Products include aero-engine test equipment; radar aerial turning gears; and specialized aircraft ground handling equipment.

Decca Radar, Ltd. (70 and R.D.S.) and **The Decca Navigator Co., Ltd.** (71). The principal Decca Radar exhibit is the aerial system of the D.A.S.R.–1 S-band surveillance radar mounted on top of a 30-ft.-high tower. The display system is presenting pre-recorded radar pictures. Decca Navigator Mk. 8 and 10 receivers; Omnitrac computer; Doppler.

de Havilland Propellers, Ltd. (141). D.H. Pottermeter electronic flowmeter; electrical fuel control equipment for the Gnome; a portable cable tester; air conditioning units; and a torque motor. Exhibits also on the Hawker Siddeley Group stand.

Delaney Gallay, Ltd. (10 and O.D.S. 9). Exhibits include thermal insulation blankets for Vanguard and Comet, and a combined heat shroud and blanket for the Lightning. Typical oil coolers are also featured together with their latest development, a high density light alloy oil cooler; wing de-icing equipment; a new type of cabin heater developed for turbine-powered helicopters; and new heat insulation felts.

Desoutter Brothers, Ltd. (222). On display is a complete range of tools, including drills, screwdrivers, nutrunners, grinders, rivet and bolt millers, nibblers and shears, a number of which are available for working demonstration.

Dexion, Ltd. (O.D.S. 22 and A). Examples of a wide range of storage and servicing applications for Dexion slotted angle in aviation.

Docker Brothers (276) A comprehensive range of surface coatings and allied materials specifically for the aircraft industry. These include a full range of M.o.A. approved schemes for civil and military aircraft, guided weapons and all forms of aerial transportation, and also a range of paints suitable for the protection of aircraft.

Dowty Group, Ltd. (35–40). A representative selection of civil and military aircraft accessory equipment; including a 14 ft. 6 in. reversing variable-pitch propeller and accessories for the Japanese YS–11 40-passenger transport; a sectioned and motorized gearbox for Vickers Vanguard; ram air turbine for providing emergency electrical services; sectioned 15 kVA bleed air turboalternator; fuel flow proportioner; turbo-fan for control of VTOL aircraft; a new range of lightweight axial piston pumps; and several undercarriage legs.

Dunlop Rubber Co., Ltd. (51). Aviation products include aircraft tyres, wheels and brakes; pneumatic components; de-icing equipment; range of compressors for ground charging pneumatic systems; inflatable seals for protecting jet-engine intakes; and a range of collapsible rubberized fabric containers.

Dzus Fastener Co., Ltd. (109). Range of Dzus fasteners, including the self-ejecting type. Supersonic and general-purpose fasteners. Of particular interest is the tension fastener and the panel-mounting fastener and strip.

H. W. Edghill and Co., Ltd. (O.D.S. 15 and J). Products include aircraft servicing, operational and production-line equipment.

Ekco Electronics, Ltd. (97 and O.D.S. 20 and C). On the indoor stand is the latest Ekco Type E190 3 cm. airborne weather radar equipment, including a dual transmitter/receiver and indicator system. The Type CE 178 VHF/DF equipment is demonstrated in the outdoor park.

Electro-Hydraulics, Ltd. (88). Manufacturers of undercarriages, jacks, valves and all hydraulic components; electrically operated valves, servo valves, and so on.

Elliott Brothers (London), Ltd. (229 and 230). Eleven divisions of the group are represented on these two stands. Exhibits cover an extensive range of flight control, instrumentation and communications equipment, including the new Elliott true-mass fuel flow meter, and the fuel management systems based upon it; units from an integrated flight control system for supersonic aircraft; the 21 Series communication and navigation system; and airborne weather radar E-RDR-ID.

E.M.O. Instrumentation, Ltd. (128). Products on show cover precision bearings, bearing torque testing instrument, a synchro torque testing instrument and a bearing washing machine

(*Continued on page 321*)

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the world
aircraft
depend on...

SEPTEMBER 2, 1960

Throughout
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aircraft
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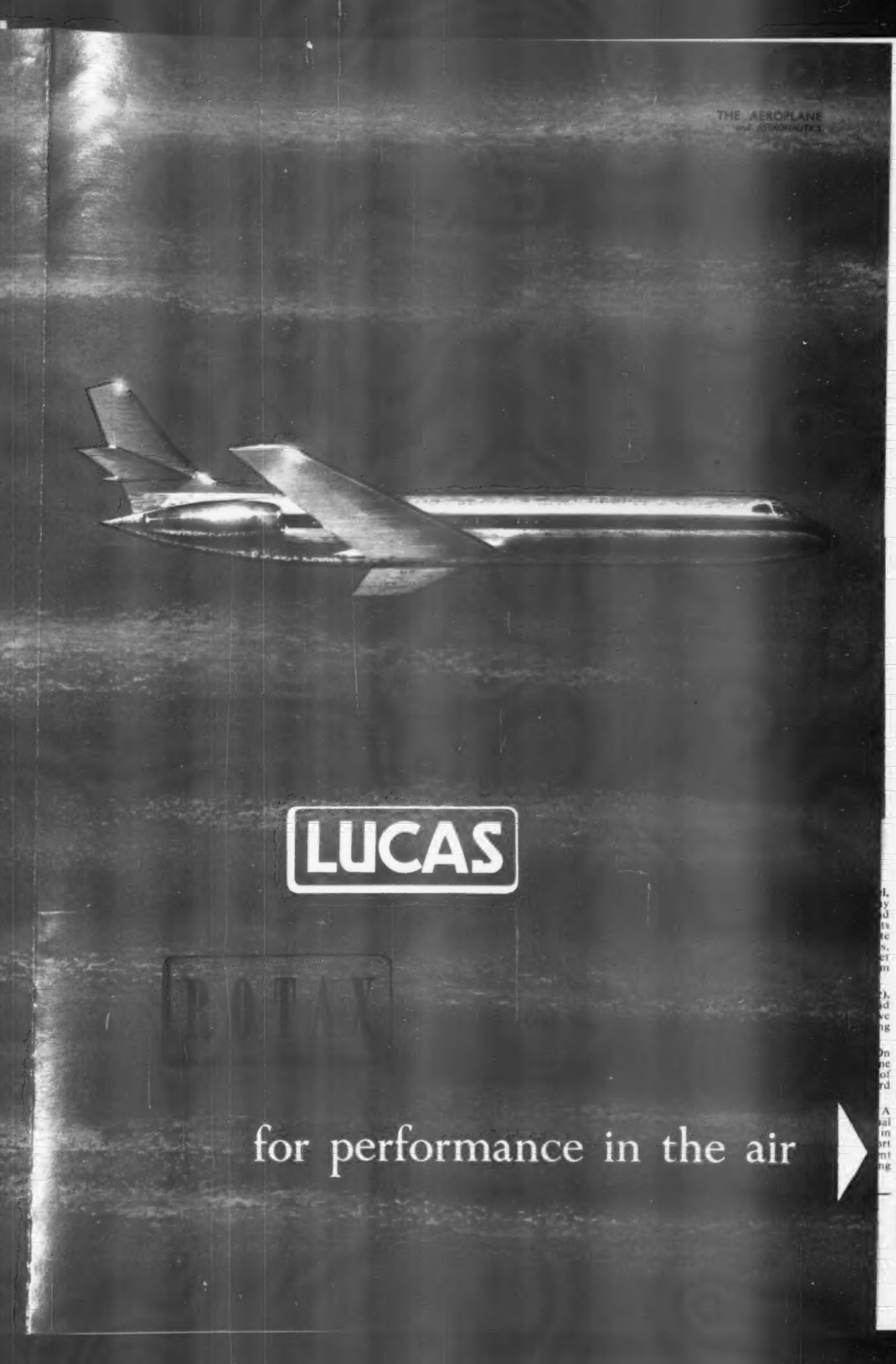
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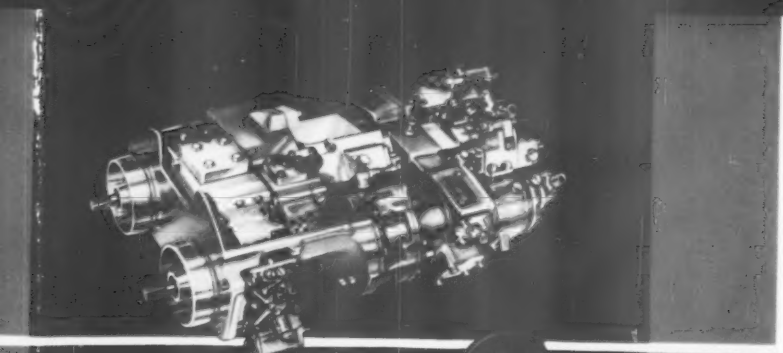

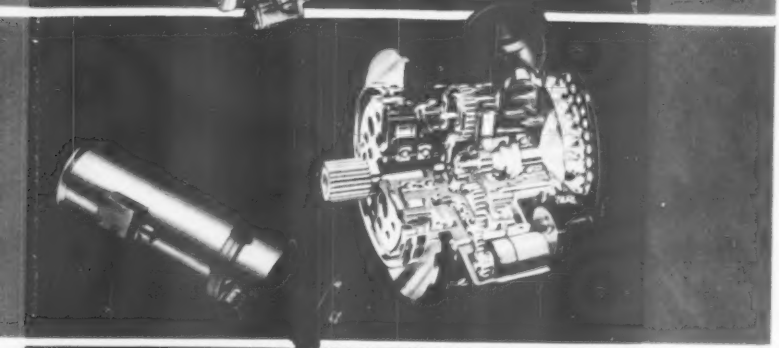

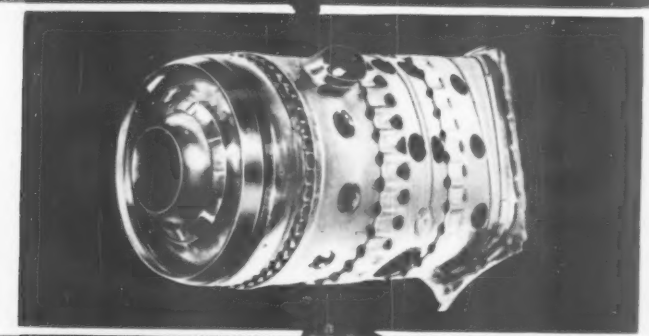

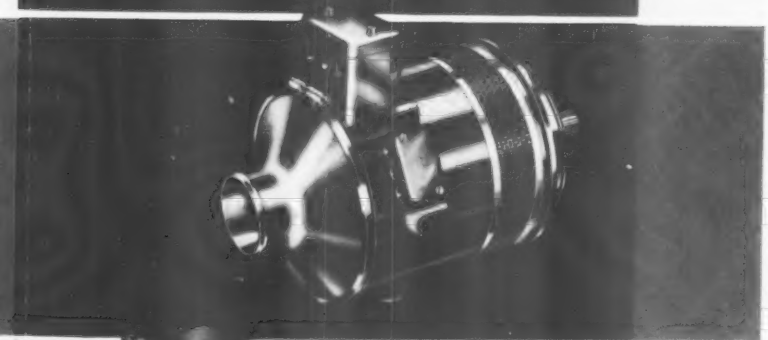

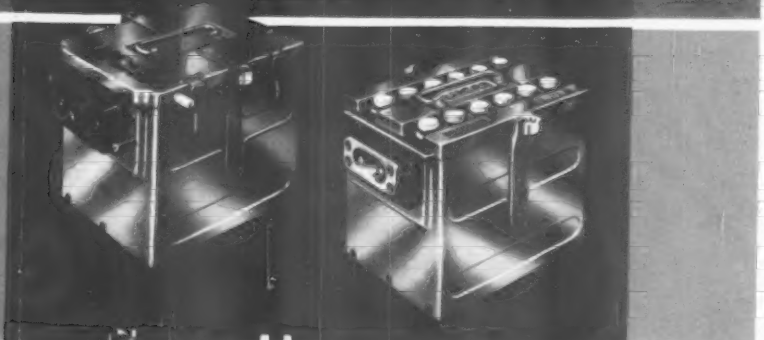

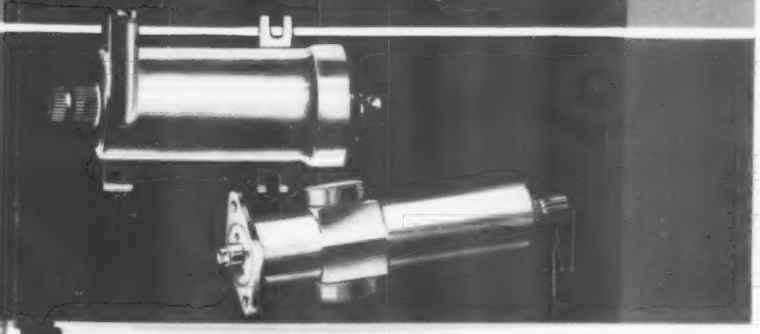

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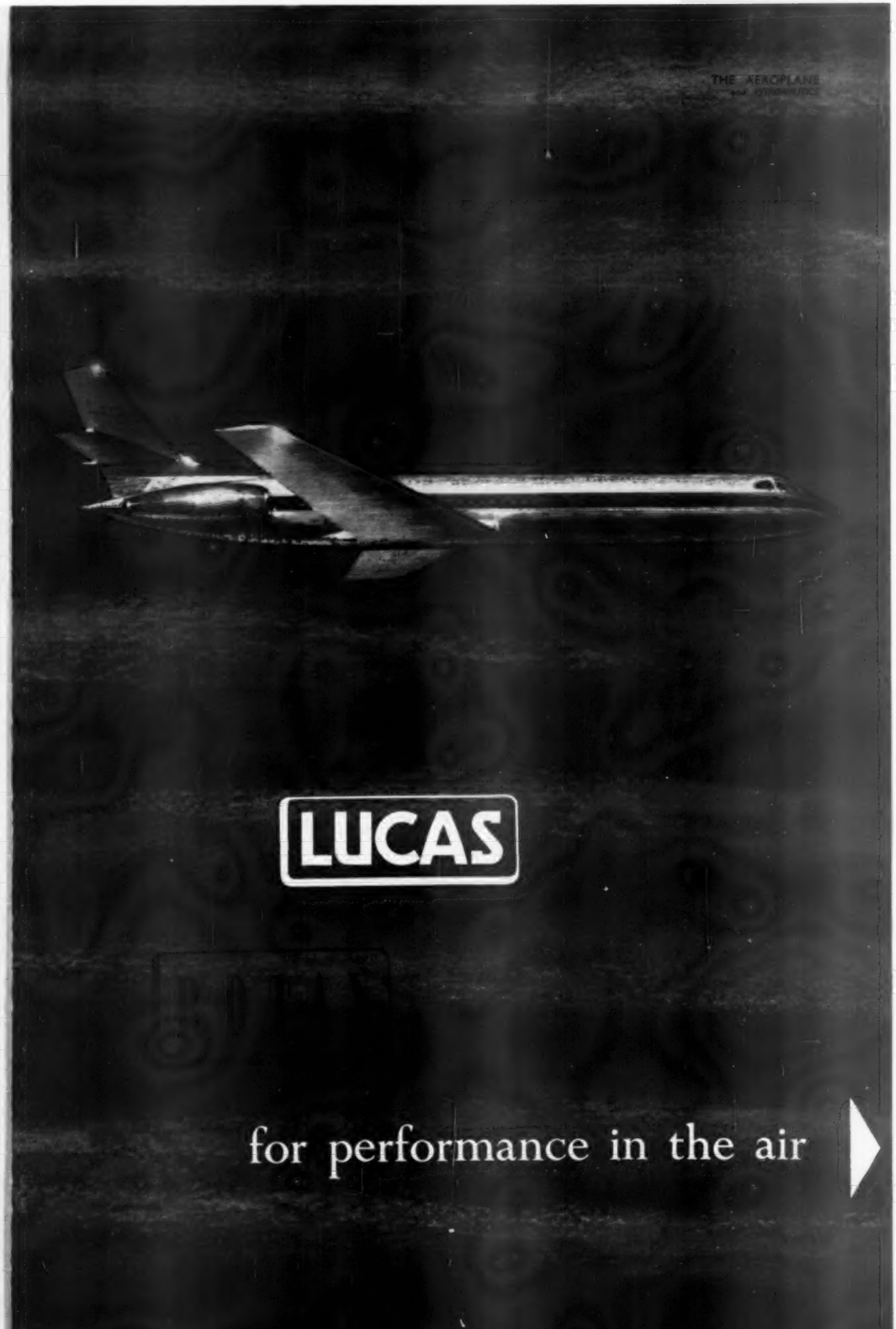
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Guide to the Static Displays . . . .

(*Continued from page 320*)

English Electric Aviation, Ltd. (283 and 285). A model of the new Guided Weapons Division instrument wing building; a precision indicator meridian (P.I.M.); part of a Mk. 7 rate gyro; and an M.I.G. gyro.

The English Electric Co., Ltd. (284). New developments cover electrical control gear, including lightweight sensing units; transistor regulators for use with either AC or DC generators; two brushless generators; and a motor-driven variable resistor for missiles.

English Steel Corporation, Ltd. (137). Drop forged components for airframes, engines and propellers; examples of torsion bars applicable to the aircraft industry; special steels used in aircraft production; high speed, carbon and alloy tool steels; comprehensive range of engineers' cutting tools; and selection of permanent magnets for electrical equipment.

E.N.V. Engineering Co., Ltd. (232). This stand is devoted to a display of precision gears with particular emphasis on spiral bevel gears for helicopter transmissions. Examples of helicopter drives for Westland and Sud Aviation aircraft will be shown together with gears for aero-engine accessory drives and for flying controls.

Esso Petroleum Co., Ltd. (85). Models illustrate the company's latest development in aircraft refuelling equipment—the Hydrafueller. This vehicle combines the functions of the hydrant servicing unit and the refuelling vehicle. Descriptive literature relating to handling and quality control characteristics of aviation turbine fuels.

Exactor, Ltd. (58). Products include test-rigs; portable pumping and filtration units; self-sealing pipe connections; missile-launching equipment; drop-tank self-sealing connections and balanced couplings.

Export Packing Service, Ltd. (131). Specialists in the packing of aircraft components, radio and electronic equipment.

Fairey Engineering, Ltd. (F and 231). On the main stand there is a full scale model of a Malkara anti-tank guided missile; a model of a Jindivik target aircraft; and a feature on ultra-wide angle lens and G.W. trial cameras. A range of aircraft hydraulic power control units, including working demonstrations, and Fairey Micro filters are on stand 231; approximately 12 Malkaras are displayed in the guided weapon park.

Ferranti, Ltd. (176 and 177). Display of the company's products including Airpass Mk. 1 airborne interception radar and pilot's attack sight system; a light fighter attack sight; the Bristol/Ferranti Bloodhound SAM system; servo control instruments; a range of gyroscopic and electronic equipment and the new Apollo A.T.C. computer.

Fibreglass, Ltd. (21). Products include fibreglass insulation and reinforced plastics for aircraft.

Field Aircraft Services, Ltd. (213). The company's customers are indicated by points of light on two World globes, whilst the background of the stand consists of coloured transparencies of the various divisions and sections within the organization, which sells, repairs, modifies and overhauls aircraft, instruments, accessories and engines.

Fireproof Tanks, Ltd. (271). Major exhibits include a flexible lightweight crash resistant Hycar fuel tank; a flexible fuel tank in reinforced Viton which can withstand extreme degrees of high and low temperatures; a range of rubber moulded components, including mouldings in Viton; recuperator bladders and diaphragms; By-clad rubber-bonded metal gaskets; a flexible drinking water tank; and models of large capacity flexible containers.

Firestone Tyre and Rubber Co., Ltd. (7). On display are a number of examples from the wide range of Firestone high speed tyres. There is also an enlarged scale model of a section through one of these tyres, indicating the special features of their construction.

T. F. Firth and Sons, Ltd. (20). Makers of upholstery fabrics and carpeting for aircraft cabins.

Thos. Firth and John Brown, Ltd. (112), and **Firth-Derihon Stampings, Ltd.** (113). Discs produced in Firth Brown vacuum-melted steels and standard F.V. 535 and F.V. 448 materials for the Rolls-Royce Conway, Tyne and Dart engines, Bristol Siddeley Olympus and de Havilland Gyron Junior engines; a selection of other types of forgings in a wide range of steels used in gas turbines and certain forgings as supplied for rocket motors and guided weapon applications.

Firth-Vickers Stainless Steels, Ltd. (234). Galley equipment, a Dart engine support ring and a Napier Gazelle gearbox casing are among exhibits featuring the company's wide range of stainless steels for the aircraft industry.

W. T. Flather, Ltd. (120). Specialized A.I.D.-tested aircraft steels; carbon and alloy steels; forgings.

Flight Equipment and Engineering, Ltd. (123). Products cover aircraft passenger and crew seats and accessories.

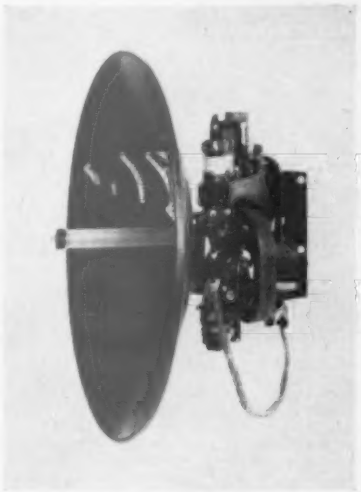
Flight Refuelling, Ltd. (194). On display are various refuelling and defuelling valves; float switches; fuel no-air, flow limiting, vent and non-return valves; ground refuelling equipment and emergency shut-down valves.

Howard Flint, Ltd. (84). Lightweight flying suits, winter flying suits; and protection equipment for airfield fire tender crews.

Formica, Ltd. (260). Display concentrates on two main aspects of industrial laminates. The first is on the use of laminates for the manufacture of aircraft assembly jigs and press tools, and the second is the use of copper-clad laminates for printed circuits for the aircraft, radar and guided missiles industries.

Fothergill and Harvey, Ltd. (247). Manufacture a wide selection of technical and industrial fabrics for the production of reinforced plastics; two of the most important are pre-impregnated glass fabrics and three-dimensional woven shapes.

General arrangement of the new automatic radio aids equipment developed by the Air Trainers Link Division of General Precision Systems.



The scanner unit of type E190 lightweight Ekco airborne weather radar which incorporates a 24-in. antenna.

An electro-hydraulic servo valve manufactured by the Hydraulic Division of Fairey Engineering.

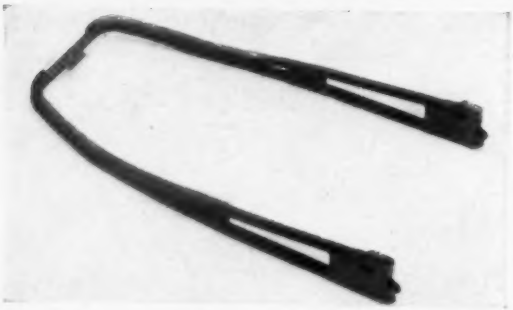
Samuel Fox and Co., Ltd. (134) and **Steel, Peach and Tozer, Ltd.** (135). A joint display on the general theme of quality control and technical advances in steelmaking. Exhibits include steel rings in Fortiweld and Jethete qualities for use in aircraft gas turbines, manufactured by rolling, forging and upset forging; and examples of carbon-chromium steel rings for aircraft bearings.

P. Frankenstein and Sons (Manchester), Ltd. (204 O.D.S. F). High altitude and pressure breathing equipment, protective flying clothing, life-jackets, a baby's floating survival cot and liferafts.

The Gear Grinding Co., Ltd. (223). On show is the Sperry/Orcutt dividing engine designed to provide an automatic means of performing angular division in standard rooms and inspection departments.

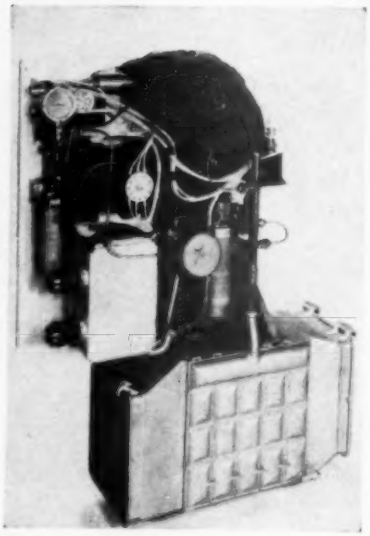
General Electric Co., Ltd. (24 and 25). A third-scale model of the new G.E.C. visual glide path indicator unit designed for use in the R.A.E. approach aid system; airport lighting; aircraft galley and fluorescent lighting equipment; vibrator drive; and a long range telemetry sender.

Guide to the Static Displays . . . .



Back frame for an aircraft passenger seat, fabricated in special High Duty Alloys Hiduminium tubing by H. C. Shepherd and Co.

This vapour cycle cooling package forms the central exhibit on the Sir George Godfrey and Partners stand in the indoor exhibition. It is now in production for the R.A.F.



General Precision Systems, Ltd. (226). The company's Air Trainers Link Division is demonstrating its new four station automatic radio aids unit, together with a new electronic procedure trainer designed to be representative of modern commercial aircraft. This latter unit has two crew positions and an eight station radio aids unit.

Girdlestone Pumps, Ltd. (172). Exhibits include aerials developed for high speed aircraft; miniature moulded connectors for electronic equipment; co-axial connectors; and pumps for various aviation applications.

Girling, Ltd. (114). Manufacturers of aircraft brakes, hydraulic control dampers; universal joints.

Gloster Aircraft Co., Ltd. (O.D.S. 10 and Q). A Gloster Miles sweeper and a Land Rover fire appliance are on show in the outside display. The sweeper has two brushes and a suction nozzle for gathering up refuse and the fire appliance has a 150-gall. water tank.

Sir George Godfrey and Partners, Ltd. (22 and O.D.S. 7). and **Godfrey Engineering Co., Ltd.** (23). The central exhibit on the indoor display is a self-contained vapour cycle cooling package now in production for the R.A.F. A complete set of Godfrey components for an air cycle system for guided weapons is also on display for the first time. The outside equipment display features the VC-50 air supply trolley, a compact unit providing a ground supply of conditioned air to ventilated suits.

The Gloster/Miles Land Rover fire appliance which can be seen in the outside exhibition.

A lightweight smoke detector produced by Graviner.

Goodmans Industries, Ltd. (262). On show is the majority of the company's range of vibration equipment, in particular, the new V.G. 108 Mk. II trunnion-mounted vibrator with a peak thrust of 5,300 lb.

The Goodyear Tyre and Rubber Co. (Gt. Britain), Ltd. (89). Range of tyres, wheels, brakes and anti-skid units including a full circle double-disc type hydraulic brake for the N.A.39; electrical and electro-mechanical anti-skid systems; and tyres incorporating the Bluedot sidewall inflation principle.

G.Q. Parachute Co., Ltd. (56). Products cover all types of parachutes, including aircrew, supply-dropping and aircraft braking types; flying clothing; and aircrew safety harnesses.

Graseby Instruments, Ltd. (272). Manufacture guided missile and control equipment comprising accelerometers; accelerometer recorders; three-axis accelerometer units; programme switches; rate gyros; yaw meters; pressure transducers and high pressure valves.

Graviner Manufacturing Co., Ltd. (142). This company's display includes smoke detectors; sealed cartridge units; Firewire; the Fenwal continuous fire detector and control unit; a flame detector; and a heavy landing switch.

Grundy and Partners, Ltd. (256). Products include radio connectors, cable assemblies, looms, junction boxes and a portable flight recorder.

Guest, Keen and Nettlefolds (Midlands), Ltd. (156). Display covers some of the company's wide range of fasteners for the aircraft industry which includes N.P.K. self-tapping cladding screws, lightweight nuts, hollow steel bolts, titanium alloy bolts and high tensile steel bolts.

J. J. Habershon and Sons, Ltd. (251). A comprehensive range of strip and bar in stainless, alloy, carbon and mild steel, together with examples of their application in the aircraft industry. The main feature is the dimensional accuracy as produced on the company's planetary hot mill.

The Hairlok Co., Ltd. (73). Manufacturers of Hairlok rubberized hair: Texfoam latex foam; and Texfoam block foam.

Hall and Hall, Ltd. (269). Hallprene synthetic rubber mouldings, sheetings and extrusions, for high and low temperature applications, including Fluoro silicone and Viton grades. Gaskets and joints in Hallite Red Aero jointing to specification DTD.378.A. Hallprene patent fluid seals and other sealing devices.

John Hall and Sons (Bristol and London), Ltd. (221). Manufacturers of aircraft finishes including aero-engine paints, dopes, varnishes, lacquers, etc.

Handley Page, Ltd. (M). Models and displays featuring the Victor B.2 and Herald; advances in laminar flow and supersonics; and other aspects of the company's research, design and production.

Harley Aircraft Landing Lamps (53). Exhibits include the model 8 Mk. 8 landing lamp for the VC10; the model 11 Mk. 11 landing lamp for the Argosy and A.W. 660; the model 6 Mk. 2 lamp for the Wasp helicopter; and other aircraft landing and taxying lamps, together with the model T.2 self-propelled mobile floodlight.

The Hawker Siddeley Group, Ltd. (L). A fully furnished fuselage of the Avro 748; the D.H. 16 ft. dia. propeller for the Canadair CL-44, the Breguet Atlantic and the Short Britannic; Acorn automatic check out and recording equipment for aircraft, missiles and ground systems; D.H. Gyron Junior with and without reheat; Double Spectre; Gnome; Gipsy Major 215; Blackburn Nimbus; Palouste air-bleed turbine; Turmo shaft turbine. Other exhibits include a wide range of electronic equipment; and models of the Group's aircraft, engines and missiles; and the Seaslug SAM in the outside missile park.

Heenan and Froude, Ltd. (75). An entirely new version of the Froude hydraulic dynamometer is on show. Designated the Froude PT20 it has a capacity of 6,000 b.h.p. at speeds up to 1,500 r.p.m. and is shown with an advanced type of control gear, specially developed to provide the particular torque/speed characteristics required in the testing of turboprop powerplants.

Hellerman, Ltd. (270). Products on show include plugs and sockets; cable sealing devices; Dymo-Mite hand embossing tool; cable binding and marking sleeves; wiring tools; wiring terminal blocks; plastic mouldings and extrusions; and information on the Phosphating method of metal treatment.

Hendrey Relays, Ltd. (106). Telemetry instruments including angular accelerometer; geological aerial survey recorder; impulse distributor; rotary switches; comprehensive range of approved relays including type 20B and other wiping contact patterns. New items are a relay type D.4705; an extension cable reel; and a phase failure relay.

Hepworth and Grandage (Yeadon), Ltd. (79). This company specializes in the production of jet turbine blades and is exhibiting a wide range of blades used for military and civil aircraft engines, including stainless steel compressor blades.

High Duty Alloys, Ltd. (191). This stand features new technical developments in processes and materials. For rolled products, the exhibits feature Hiduminium R.R. 58 sheet for difficult stretch forming operations, while forging developments cover close tolerance steel and Nimonic forgings, and the production of formed ring-rolled forgings in Hiduminium. Complex extruded sections and pressure die castings are also exhibited.

High Pressure Components, Ltd. (122). Manufacturers of Gyp range of pipe-to-pipe and re-usable hose couplings; various types of charging and relief valves.

H. M. Hobson, Ltd. (167). Products include various flying-control feel-simulator units; flap-control units; constant-speed alternator drives; powered flying controls; re-heat control systems; air/fuel ratio controls; Microjet pressure-ratio controls.

H.M.L. (Engineering), Ltd. (O.D.S. 1 and X). Medium size universal hydraulic mobile test rigs; medium size hydraulic component test bench; and small gas turbine units used for air pressurization.

Honeywell Controls, Ltd. (286). The main feature of this stand is the company's new Universal Adaptive Autopilot which automatically re-adjusts itself to changing dynamic conditions of flight. Other exhibits are micro switches, direct reading oscillographs, a modular strip recorder and a pressure ratio indicating system.

Hordern-Richmond, Ltd. (91). The main feature of this stand is laminated wood helicopter main and tail rotor blades; there is also a display of blanks for the aircraft industry produced by the new Templet die process. Other items on show include Hydulignum and Jabroc laminated compressed wood press tools; Permaglass aircraft ducting and drill, trim and assembly jigs; Permaflon processed P.T.F.E. components.

Houchin, Ltd. (O.D.S. 23 and Y). On show is the company's latest Mk. 3 60 kVA 400 c.p.s. ground power unit for supplying electrical power for servicing aircraft radio, radar and other AC electrical equipment.

The Hughes-Johnson Stampings, Ltd. (60). Manufacturers of drop forgings of the more intricate type, in carbon, nickel, nickel chrome and all alloy steels, non-ferrous high nickel chrome alloys, copper, aluminium alloys and titanium alloys.

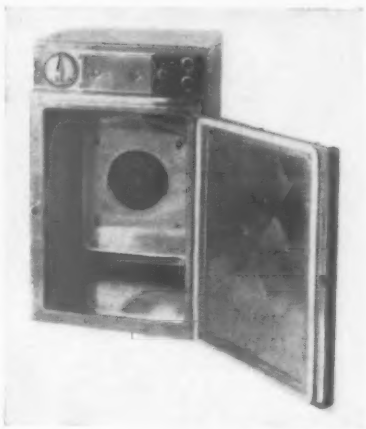
The Hymatic Engineering Co., Ltd. (264). Valves form the theme of this stand where there is a very wide selection of pneumatic equipment for aircraft and missile applications and equipment designed to maintain the operational efficiency, comfort and safety of aircrew.

Alfred Imhof, Ltd. (205). On show is a range of racks and cases for electronic control equipment and for test instruments, together with accessories and the Imlok system of construction. Among the most interesting items is the Imrak International series which is rapidly gaining acceptance as a housing for control equipment.

Imperial Chemical Industries, Ltd. (Metals Division) (111). Metals for today and tomorrow is the theme of this display and one of the chief exhibits is the nose wheel assembly of the D.H. Sea Vixen, which incorporates a number of components made from I.C.I. titanium alloys. Examples of beryllium, niobium, hafnium, and zirconium components are on show, together with a range of wrought aluminium products made by the Imperial Aluminium Co.

Imperial Chemical Industries, Ltd. (Paints Division) (110). Details of the B.E.A. Vanguard chemically resistant paint scheme incorporating I.C.I. metal pretreatments and aircraft finishes, together with information on the company's range of metal pretreatment and painting systems to meet current specifications.

Imperial Chemical Industries, Ltd. (Plastics Division) (125). Products include Perspex acrylic sheet; Diakon acrylic moulding and extrusion material; alkathene; Darvic rigid p.v.c. sheet; Flovic; p.v.c. copolymer foil; and Fluon.



This new General Electric air-circulation oven has been designed for Grumman Albatross amphibians of the R.C.A.F.

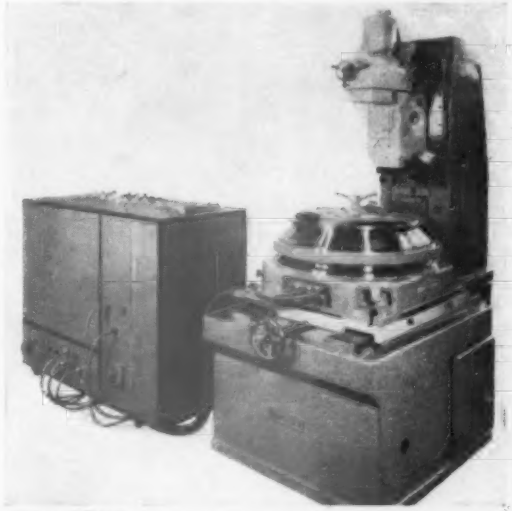
Integral, Ltd. (166). Equipment on public display for the first time includes axial piston swash-plate hydraulic pumps; electric-hydraulic pump units; various other hydraulic pumps; and motor pump units.

Irving Air Chute of Great Britain, Ltd. (216). Landing brake parachute for the Bristol 188; a parachute assembly for the recovery of target aircraft photographic equipment; air-crew ejection and static seat parachutes; a professional parachute assembly; and other safety equipment.

Jessop-Saville, Ltd. (33). Stand illustrates the company's range of ingots produced from vacuum arc and vacuum induction melting furnaces up to the largest 24 in. diameter ingots in steel weighing 3 ton. Jessop-Saville's range of turbine disc steels has been extended to include H.53 (12% chromium base alloys); and G.80 and G.81 high strength nickel base alloys.

K.L.G. Sparking Plugs, Ltd. (1). See Smiths Aviation Division.

Kelvin and Hughes (Aviation), Ltd. (3 and O.D.S. 16). See Smiths Aviation Division.



The Sperry/Orcutt dividing engine produced by the Gear Grinding Co., in conjunction with Sperry. Here it is seen in use with an HPE fine boring head on an annulus gear.

A group of gas turbine blades manufactured by Hepworth and Grandage.

The Kenilworth Manufacturing Co., Ltd. (274). On this stand the emphasis is on the company's D.B. Toolform plastic tooling service for the aircraft industry. Other products include various fillers and jointing compounds.

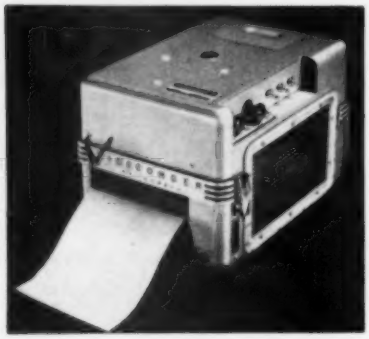
Kent Alloys, Ltd. (174). High quality castings and machined items in aluminium, magnesium and copper-based alloys.

The Walter Kidde Co., Ltd. (185 and O.D.S. F). New items on show are lightweight portable fire extinguishers; inflatable radar reflectors for use with life rafts, etc.; and inflatable structures for airport ground applications. Survival inflation gear; portable oxygen breathing sets; aircraft emergency oxygen systems; and glass fibre units are also on this stand.

King Aircraft Corporation (57). Airframe and engine components; flexible metallic hose; and cargo control equipment. Filtration specialists.

In the outside exhibition Houchin have their latest Mk. 3 60kVA 400 c.p.s ground power unit.

Guide to the Static Displays . . . .



A 14-channel direct reading oscillograph, one of two Visicorder instruments by Honeywell for use in wind tunnel research, communication studies and other applications.

Lancashire Aircraft Co., Ltd. (O.D.S. 11 and N). Manufacturers of the Prospector light aircraft for passenger/freight carrying and crop spraying.

Lancefield Aircraft Components, Ltd. (154). Main exhibits include Comet first class passenger chairs; Comet pilot and navigator seats; and all types of radar waveguides.

Laporte Chemicals, Ltd. (261 and O.D.S. 18). Indoor stand features H.T.P. as a safe, controllable, compact and instantaneous source of propulsive energy for aircraft and missile applications. The Metklens range of A.I.D. approved metal cleaning products are demonstrated on the outside stand.

Latex Upholstery, Ltd. (281). Examples of aircraft passenger seat upholstery; light-weight upholstery; cushioning; escape chutes; Kargo Pak cabin freight containers; and furnishing materials.

Lep Transport, Ltd. (235). Specialists in the packing and shipping of aircraft and components including tropical packing and preservation, salvage and transportation of damaged aircraft.

Lodge Plugs, Ltd. (117). Exhibits include aviation sparking plugs; jet engine igniters and thermocouples; aviation plug servicing equipment and Sintox precision engineering ceramics.

Joseph Lucas (Batteries), Ltd. (95 and O.D.S. 21 and B). Range of airborne and ground starter aircraft batteries.

Joseph Lucas (Gas Turbine Equipment), Ltd. (93 and O.D.S. 21 and R). Display covers fuel system, combustion and hydraulic equipment. Exhibits include a hydraulically driven boost pump for low pressure fuel supply; a high-speed hydraulic motor; and a quick-release pipe coupling.

Lucas-Rotax, Ltd. (94 and O.D.S. 21 and B). See Joseph Lucas, Ltd., and Rotax, Ltd.

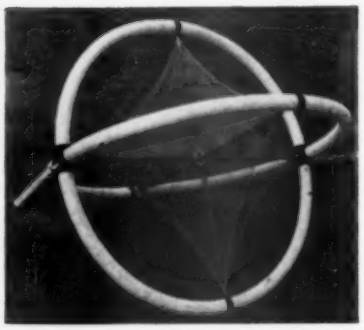
Lucas-Rotax (Australia) Pty., Ltd. (115 and O.D.S. 21 and B). See Joseph Lucas, Ltd., and Rotax, Ltd.

Magnesium Elektron, Ltd. (209). Manufacturers of magnesium alloys, including zirconium- and thorium-containing ranges.

William Mallinson and Sons, Ltd. (244). Specialists in lightweight laminates for aircraft floors and bulkheads. The Mallite EGB replacement floor for Viscount 800/810s is featured, together with a section of a galley unit showing the use of Mallite mealboxes and barboxes.

Manchester Oil Refinery, Ltd. (42). A demonstration of M.O.R. non-destructive flaw detection inks, both magnetic and dye penetrants. Special attention is being paid to slow-settling Supramor electro-magnetic ink and the Varimor (solvent process) dye penetrant.

Marconi's Wireless Telegraph Co., Ltd. (13 and 14), **Canadian Marconi Co., Ltd.** (11), **Amalgamated Wireless (Australasia), Ltd.** (15), and **Marconi Instruments, Ltd.** (12 and O.D.S. M). A new series of airborne VHF communications equipment Type AD160 which is fully transistorized with the exception of the transmitter output stage; Type AD260 VHF navigation and approach guidance equipment for use with VOR or ILS; Types AD360,



A 3ft. diameter inflatable radar reflector produced by Walter Kidde.

AD712 and AD722 automatic direction finders; and the AD2300B Doppler Navigator. A parametric amplifier which promises to give a 25% range improvement to 50 cm. radars; closed circuit television; HF and VHF transceivers; the CMA-623 Doppler sensor (Dagmar); and electronic measuring instruments.

Marston Excelsior, Ltd. (126). Examples of the heat exchangers in brazed light alloy, titanium, and stainless steel; sheet metal work and machined components; flash-butt welded titanium engine rings and a range of cooling devices for electronic equipment. Non-metallic products on display include radomes, aerial covers, and laminated plastic fabrications.

Martin-Baker Aircraft Co., Ltd. (227). A Mk. GQ5 fully automatic ejection seat as chosen for the Lockheed F-104G Starfighters of the West German, Netherlands and Belgian Air Forces. Two new features on this seat are the inertia shoulder harness mechanism and the drogue link line guillotine.

M.B. Metals, Ltd. (188). New products on show include pressure switches for pneumatic and hydraulic circuits; aircraft lighting switches; full range of co-axial and other plugs and sockets; and electronic controllers for high-speed welding operations.

Mechanism, Ltd. (279). New items among the company's range of aircraft instruments include a transmitting and indicating accelerometer which has a separate indication that a heavy landing has occurred; a completely redesigned fatigue meter with eight counting levels; a differential pitôt pressure switch; a differential pressure recorder; two barometers and a height warning system.

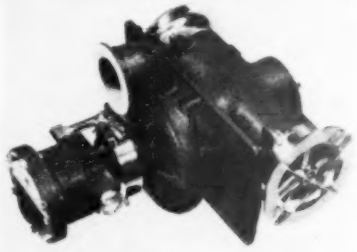
Metachemical Processes, Ltd. (107). Dalic process of selective area plating of all metals, used in the aircraft industry for reclamation and corrosion prevention; extensions of the applications of Micrograin nickel used for de-icing protection; and the company's new development, batteries which are a primary cell based on Indium of reasonably small dimensions for use with transistorized equipment.

McMichael Radio, Ltd. (214). Products include radio, electrical and electronic equipment; aircraft instrumentation units; and aircraft aerials.

Microcell, Ltd. (208 and O.D.S. 17). The indoor stand is devoted to aircraft seating and the new double-seat version in the executive de-luxe, executive and economy-tourist classes is on show. Glass-fibre rocket launchers and a range of electronic instruments are in the outside display.

Ministry of Aviation (B and O.D.S. 3). R.A.E. exhibits include an 8-track magnetic tape recorder for missile flight testing; a 16-track recording unit for aircraft; radar-directed binoculars; samples of rain erosion and test equipment used to simulate typical erosion conditions; a rate of descent meter for measuring helicopter landings; and a telemetry system for use with aircraft. A rain gun for wind-tunnel rain simulation is shown by A. and A.E.E.; a broadband telemetry system for use with guided missiles; exhibits illustrating some of the R.P.E. experimental techniques; and civil aviation A.T.C. equipment are also on this stand.

Mitchell Hydraulics, Ltd. (267). Display includes a "fly power-horse power" chair used for subjecting pilots and aviation medicine research workers to acute vibration; a range of missile servo-valves; a high-speed grinding spindle; and single- and two-stage hydraulic valves.



This Lucas hydraulically-driven boost pump supplies low-pressure fuel from the aircraft tanks to the engine's main high-pressure fuel pumps.

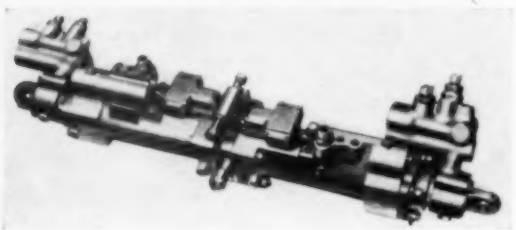
M.L. Aviation Co., Ltd. (27 and O.D.S. P). Outside there are examples of missile ground-handling equipment; the M.L. Coolair Mk. 5 mobile aircraft air conditioning unit; an air-crew coaching conditioned air trailer; and an aircraft carrier universal handling trolley. The indoor exhibit covers the company's activities in the electronic, electrical and mechanical fields.

The Mollart Engineering Co., Ltd. (48). Manufacture a range of gauges, jigs, tools, fixtures and special-purpose machine tools.

The Mond Nickel Co., Ltd. (175). Members of the company's Development and Research Department are available on the stand for consultation, and a range of technical publications is displayed.

Morfax, Ltd. (O.D.S. 4 and U). Principal exhibits are a series of specially designed ground-service and transport stands for the Rolls-Royce Tyne; an improved hydraulic elevating strip build platform for the vertical assembly and dismantling of the larger gas-turbine engines; a lightweight air freight stand for the Dart and a transport stand for the Napier Eland.

(*Continued on page 325*)



A tandem unit Lockheed Servodyne which provides a fully duplicated power control service for the flying controls of the Sud-Aviation Caravelle.

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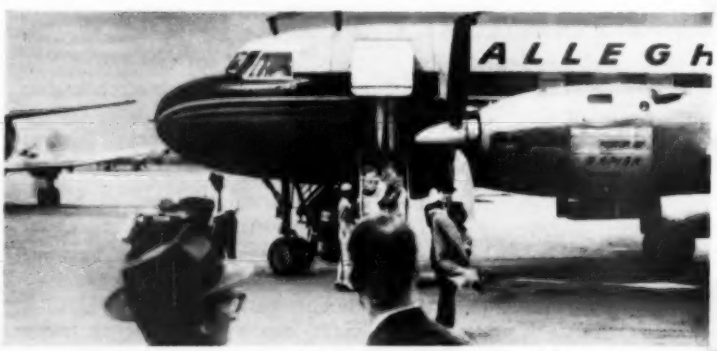
NAPIER'S PLACE IN THE SKY

In this quick, pictorial 'round and about' we outline Napier's place in the sky. Allegheny Airlines . . . Royal Navy . . . Westland Wessex . . . Butler Aviation . . . R.C.A.F. . . . Type 192 Helicopter . . . —in many interesting developments in the international 'skyscape' Napier engines are playing a significant part. And we are at Farnborough to welcome all our friends. Come and see us.

R.C.A.F. CL 66's ENTER SERVICE

Five CL 66's are now in service with the R.C.A.F. The CL 66 is the Military version of the Canadair 540 aircraft powered by Napier Eland Turbo-props. The R.C.A.F. has placed an initial order for ten of these aircraft.



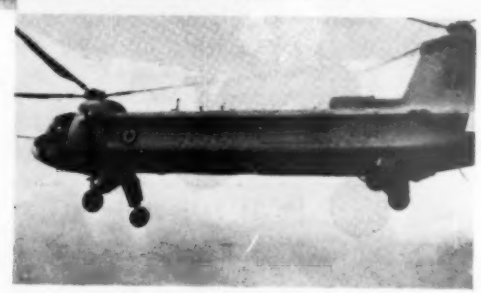
'FLIGHT PHOTOGRAPH'

'PAY-AS-YOU-FLY' COMMUTERS

leave an Allegheny Airlines Convair 540 powered by Napier Eland turboprops.

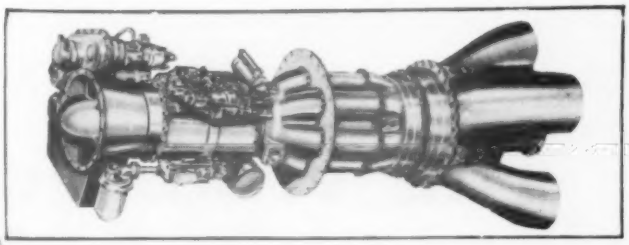
LONDON TO ROME

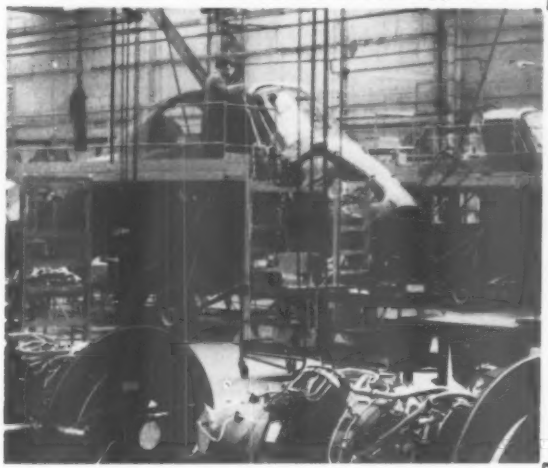
in 8 hours 13 minutes elapsed time in June. This was the fastest time yet recorded by a helicopter, the Westland-Bristol Type 192 powered by a Napier Gazelle engine.



GAZELLE FREE TURBINE

(1,650 s.h.p.) designed for helicopters with any-angle installation between vertical and horizontal. It was the first gas turbine engine in the world to receive M.o.S. 150 hour Helicopter Type Approval and to clear cold weather trials in Canada in one go. It is now on tropical trials in the Wessex and the Type 192.



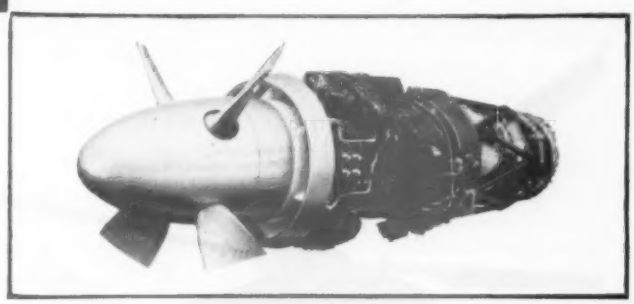


THE GAZELLE 512

The latest development of the well-tried Napier Gazelle is the Gazelle 512. This engine is suitable for multi-engined helicopters and has a radial air intake and direct drive to the helicopter gear-box and is being considered for several helicopter applications.

ELAND TURBO-PROP

is for new airliners and the conversion of piston engined airliners. The Eland is rated at 3,500 e.h.p. and approved by British A.R.B., American F.A.A. and the Canadian D.O.T.



WESTLAND WESSEX

powered by the Napier Gazelle is now in service with the Royal Navy.

SIXTEEN TWENTY-EIGHT ONE HUNDRED AND FIFTY MILLION

Spraymat has become the universally adopted electrical de-icing system. Spraymat protected aircraft are now operating in *sixteen* countries. Some 150,000,000 miles have been flown with Spraymat. Manufacturers round the world are now using Spraymat on 28 types of aircraft. Recent additions include the Lockheed Electra and F.104, the Argosy, Blackburn NA. 39, Victor Mk. II, Sabreliner, Caravelle, Britannia and the German Transall Cargo aircraft.

SIERRACOTE LICENCE AGREEMENT

Napier, in a recently concluded agreement with the Sierracin Corporation, Burbank, California, received the exclusive rights to manufacture, use, and sell the "Sierracote" and "Sierraglo" processes in the United Kingdom and Europe.

"Sierracote" is a transparent, conductive coating used for heating aircraft windscreens, and cockpit canopies, and other industrial applications where de-icing or de-misting is required. "Sierracote" therefore complements the Napier "Spraymat" de-icing system.

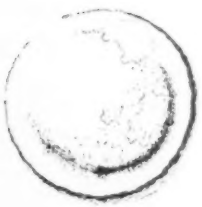
ELANDS FOR BUTLER

A radar equipped, pressurized, jet prop Convair 540 airliner has been bought by Butler Aviation, Chicago, and is to be converted for executive transport use. It will be capable of over-weather coast-to-coast non-stop flights at speeds of more than 5 miles per minute. Power is provided by Napier Elands.

VISIT NAPIER STANDS 'N' & 119

Member of the English Electric Group **D. NAPIER & SON LTD., LONDON, W.3**

THE VITAL WORKER



Today's advanced technical knowledge is stretching for the moon — and reaching it. To achieve these hitherto unconquered heights, scientists take for granted the inherent quality of much of the basic equipment they use. It is a tribute to the vital workers and research engineers who produce it, that the scientist is rarely let down. In the field of high pressure hose lines there is nothing to surpass Aeroquip

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the strongest bolt in the world

It would be reasonable to assume that we could now sit back complacently knowing that we have produced the strongest bolt in the world. This is not so. The production of a fastener with a tensile strength of 260,000 p.s.i. is not the ultimate in fastener design. It is simply another logical triumph in a lifetime of industrial achievement. The backing of the largest research and development organisation of its kind in the world maintains Unbrako, leading manufacturers of the world's finest fasteners, five years ahead of the rest.

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Advanced Design Division

on Stand 259 at Farnborough

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the first lightweight flexible pipe assembly which is

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Type 'W'

stainless steel seamless flexible pipe assemblies with welded couplings

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TA 4028

Guide to the Static Displays . . . .

(*Continued from page 324*)

Murex Welding Processes, Ltd. (47). Aircraft ground power units, welding electrodes and equipment and positioning units are featured on this stand. A selection from the wide range of Murex welding accessories including welding helmets, electrode holders, protective clothing is also displayed.

Murphy Radio, Ltd. (248). Manufacture radar, communication and navigation equipment for aircraft and ground use; telemetry and test equipment.

D. Napier and Son, Ltd. (N and 119). A quarter-scale model of the Gazelle 512; a full-scale cutaway and rotating model of the standard Gazelle powerplant; the Eland 504; and a single-barrel Scorpion rocket motor, are on the main stand. The Sierracote coating for heating windscreens is featured on stand 119, together with Spraymat for helicopters.

Negretti and Zambra, Ltd. (161). A direct-reading fuel-flow integrator; temperature and pressure units and capsule stacks for control purposes; pressure switches; gauges for boost, altitude and pressure; test-bed thermometers; test barometers and meteorological instruments.

Louis Newmark, Ltd. (157). New transistorized equipment which has not been shown before includes a lightweight three-axis helicopter stabilizer/autopilot and an aircraft servo systems response test set. Another helicopter autopilot and a communications multi-channel traffic analyser are also exhibited.

Newton Brothers (Derby), Ltd. (16). Automatic carbon pile voltage and current regulators, including transistorized versions; rotary transformers and converters; a 400 c.p.s. rotary inverter; and servo-motors.

Normalair, Ltd. (81), with **Normalair (Australia) Pty., Ltd.** (82), and **Normalair (Canada), Ltd.** (83). The theme of this exhibit is the present and the future, the "future" being represented by a three-dimensional lunar scene. The "present" is shown by a display of aircraft air-conditioning, pressurization and oxygen equipment which is in current production, including a pilot's seat mounted emergency and ejection oxygen installation; electro-pneumatic pressure control; liquid oxygen and vapour cycle cooling equipment for the Vickers VC10; and a miniature lightweight refrigerant compressor.

A redesigned Mechanism fatigue meter. Completely interchangeable with the company's previous type, it has eight counting levels.

Northern Aluminium Co., Ltd. (155). Three new developments are exhibited: aircraft plate in Noral B19S; Noralduct roll-bonded heat-exchanger plate used for the cooling of electronic equipment; and hollow sheet incorporating ducts. The company's new aluminium rolling mill is also illustrated.

Omes, Ltd. (145). Stand features electrically upset, press and drop forgings including various types of blade forgings; integral bladed rotors for small axial and centrifugal gas turbines in titanium, nimonic and aluminium bronze; and a selection of drop forgings.

Optical Measuring Tools, Ltd. (190). The O.M.T. 30-in. automatic indexing rotary table with E.M.I. electronic positioning control is featured, together with the company's roundness measuring machine.

Palmer Aero Products, Ltd. (233). A new development, corrugated P.T.F.E. flexible pipes, is included among a comprehensive range of products. Palmer-Parmatic aircraft filters; pipes, including Fluoroflex (P.T.F.E.), Silvoflex (rubber), Palmaflex (metallic flexible), and Corroflex (corrugated rigid); wheels and brakes; de-icing equipment; seals and mouldings complete the display.

R. and J. Park, Ltd. (195). Exhibits consist of models of aircraft the company has packed and shipped throughout the World during the past 30 years, from the Puss Moth to the Hunting Jet Provost.

Plannair, Ltd. (224). Manufacture a wide range of axial-flow blowers and turbo air compressors for various airborne and ground applications.

The Plessey Co., Ltd. (66), and **Wireless Telephone Co., Ltd.** (68). New equipment on these stands includes the PTR 170 lightweight airborne UHF transmitter/receiver and the PV132–135 wideband aerial multi-coupler system for use in the HF range. The latest version of the AN/ARC 52 UHF airborne equipment; a telebriefing audio amplifier; an HF preselector adaptor unit; and ground-to-air UHF equipment is also on show.

The double executive de-luxe seat with intermediate cabinet from the Microcell range of aircraft seating.

Power Auxiliaries, Ltd. (67). A comprehensive display of Plessiflex stainless steel, seamless flexible hose and couplings, including a starter duct, a lined duct, pre-bent hose, and all-welded hose assemblies for the Napier Eland.

Precision Rubbers, Ltd. (52). Typical examples of the company's components such as "O" ring seals, sleeves, bushes, diaphragms, mouldings, extrusions and rubber-to-metal bonded parts in natural, synthetic and silicone rubbers to various specifications.

The Martin-Baker Mk. GQ5 fully automatic ejection seat as chosen for the Lockheed F-104G Starfighters of the West German, Royal Netherlands and Belgian air forces.

Prichett and Gold and E.P.S. Co., Ltd. (240). A comprehensive selection of aircraft batteries can be seen on this stand. The highlight of the display is the two Dagenite lightweight batteries introduced last year for civil aircraft. Both are 24V. and similar in basic design to the Dagenite unspillable battery which is fitted as standard equipment on the Viscount, Vanguard and Comet 4.

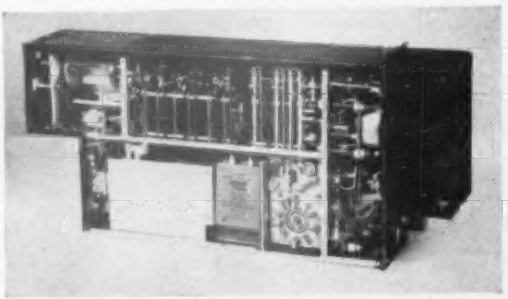
R. B. Pullin and Co., Ltd. (253). Range of size 18 synchros and size 15 servo motors and motor generators for both 400 and 50 c.p.s. operation; a remote position servo-indicator; an electrically operated traffic barrier; and various measuring and control instruments.

Purefoy Unit Tooling, Ltd. (165). Specialists in the design and manufacture of standard parts and components for jigs and fixtures.

Pye Telecommunications, Ltd. (162 and O.D.S. 12). On the indoor stand there is HF and VHF communications equipment for runway control and ground-to-air communication; ILS; VHF monitor receivers; transistorized transhailers; and a transducer and amplifier manufactured by W. G. Pye for the R.A.E. A 1 kW transmitter and other long-range VHF equipment are in the outdoor display.

The Pyrene Co., Ltd. (63 and O.D.S. E). Aircraft hand fire extinguishers charged with CO_2 or "wet water"; fire extinguishing installations using CO_2 or methyl bromide; smoke and fire detecting equipment; the Pyrene impact crash switch and under-floor viewer. Portable fire appliances using CO_2, foam, dry chemical, special liquids or water, and the Mark 6A airfield crash tender.

The Rawlplug Co., Ltd. (74). Rawlnut shock and vibration-proof fixing devices for aircraft are featured, including sealed end units to protect the thread.

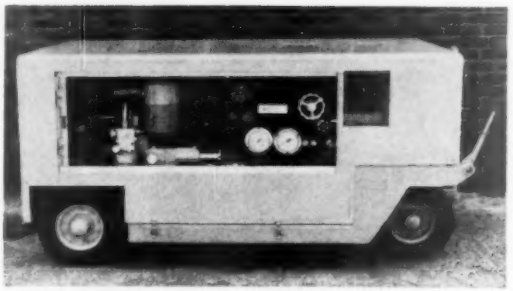


Marconi's are introducing an entirely new range of airborne radio units and navigational aids—the Sixty Series. This is the VHF transmitter Type 6400, with side panel removed.

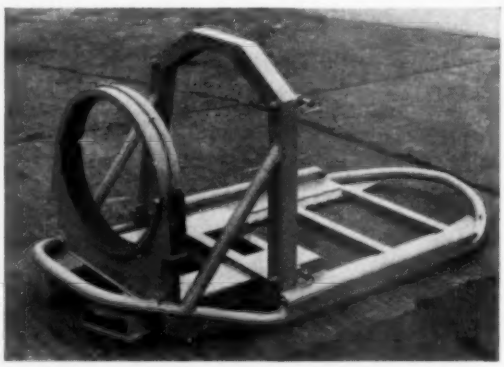
Guide to the Static Displays . . . .

Redifon, Ltd. (18 and 19). The Communications Division is exhibiting a working model of its Type G420 series of SSB/ISB transmitters, and three new pieces of equipment; the type GR410 100-watt transistorized SSB radiotelephone, the A43 UHF transmitter/receiver, and the Type G190 1 kW. VHF transmitter. An Air Traffic Control ground-to-air radar simulator is shown by the company's Flight Simulator Division.

Rellumit (London), Ltd. (129 and O.D.S. H). Products include microfilters fitted with Lenticulaire-type elements for aircraft refuelling; bulk installation filters; Rellumit Fipoca filters; air eliminator and coarse filter combined unit; floating suction loading arm; underwing pressure fuelling hydrant dispenser; one-man operated motorized hydrant dispenser for overwing fuelling; mobile hose elevator unit for underwing refuelling; and water separator microfilter unit.



The H.M.L. Engineering Mk. 5 universal hydraulic mobile test rig.



This stand has been designed by Morfax to carry a Tyne powerplant, less the oil cooler, in the freight hold of the Vickers Vanguard. It is provided with fork lift entries at the rear.

W. H. Saunders (Electronics), Ltd. (100). Microwave Division is exhibiting a new range of ferrite isolators and flexible waveguides. The company's Industrial Electronics and Precision Gears Divisions are showing resin encapsulated and open type transductors, and a range of precision gear trains.

Sangamo Weston, Ltd. (92). Instruments for the indication of temperatures, pressures, control surface positions, turbine speeds and electrical power. Navigational aids, ground test sets, ice warning system, relays and electrical measuring instruments.

Joseph Sankey and Sons, Ltd. (69). Display includes the centre section for Bristol Siddeley Sapphire; diffuser for Bristol Siddeley Proteus; spinners manufactured for de Havillands; sample bellows piece manufactured in stainless-steel with five convolutions; blade ring assembly and burner plate for Bristol Siddeley Viper; flame tube for de Havilland Goblin; and de-icing equipment.

(*Continued on page 327*)

Reynolds (Packaging), Ltd. (46). On display are various types of packs made by the company for the packaging of aircraft, electronic and radio components.

Reynolds Tube Co., Ltd. (215). Exhibits deal with the supply of cold-drawn seamless steel tubing for the aircraft industry and the company's skill at manipulation and assembly; rectangular flash-welded rings; and the Reynolds precision hollow extrusion process.

R.F.D. Co., Ltd. (98). Manufacturers of rescue and survival clothing, dinghies and packs. Exhibit comprises a scale model of the company's 26 Universal Lifecraft Mark 1c.

Rolls-Royce, Ltd. (K). Exhibit covers developments of current engine types and the new second generation by-pass engines now under development. Jet-lift for civil and military aircraft is also featured. Six types, the Conway by-pass engine; the RB. 141 by-pass engine; the Tyne turbo-prop; the civil Avon turbojet; the military Avon RB.146; and the RB.108 jet lift engine are displayed.

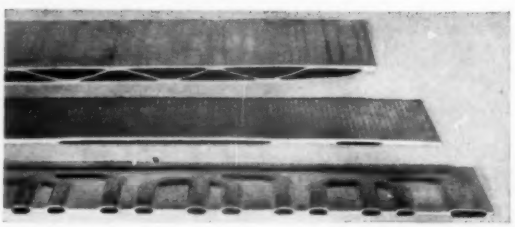
Rotax, Ltd. (116 and O.D.S. 21 and B). Emphasis is placed on generating and starting systems and on show is a constant-speed drive starter and three versions of a solid-rotor alternator. A central air data system is also exhibited together with a full range of switchgear and actuators, transducers and transistorized control units.

Rover Gas Turbines, Ltd. (O.D.S. 19 and D). On display are the IS/60 ground power unit and the IS/60 aircraft auxiliary powerplant as used in the Vulcan. This latter unit is designed to provide emergency electrical power in the air and an independent supply of compressed air for engine starting.

Royston Instruments, Ltd. (108). Produce electronic electro-mechanical and optical instruments, in particular data recording and processing equipment such as the MIDAS flight and crash recorder.

Rubery, Owen and Co., Ltd. (87). Manufacturers of aircraft fasteners.

Salford Electrical Instruments, Ltd. (26). Exhibits include a new thermo-electric cooling element and a series of multirange test sets.



Three types of Northern Aluminium Noralduct roll-bonded heat exchanger plate: standard, flat one side, and flat on both sides.

The double lift type multi-purpose handling trolley produced by M.L. Aviation.

of
communications
navigational aids
missile control
electronics
systems

"Rapid Mobility" was again re-emphasised in the Defence White Paper, which spoke of the Army's needs for tactical mobility.

The Modern Aircon Container is easily transportable by land, sea or air and is an easy solution to the problems of providing a compact base in any terrain at short notice, suitable for a mobile communication centre, a D.F. station or beacon.

We custom-build Aircon units to meet your system installation requirements, and look forward to hearing your problems and offering our solutions. Come and meet us at Farnborough during the S.B.A.C. exhibition, or at any time at our works at Haddenham.

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Outside Equipment Exhibition
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September 5-11, 1960

AIRTECH LIMITED HADDENHAM, BUCKS Tel.: HADDENHAM 422

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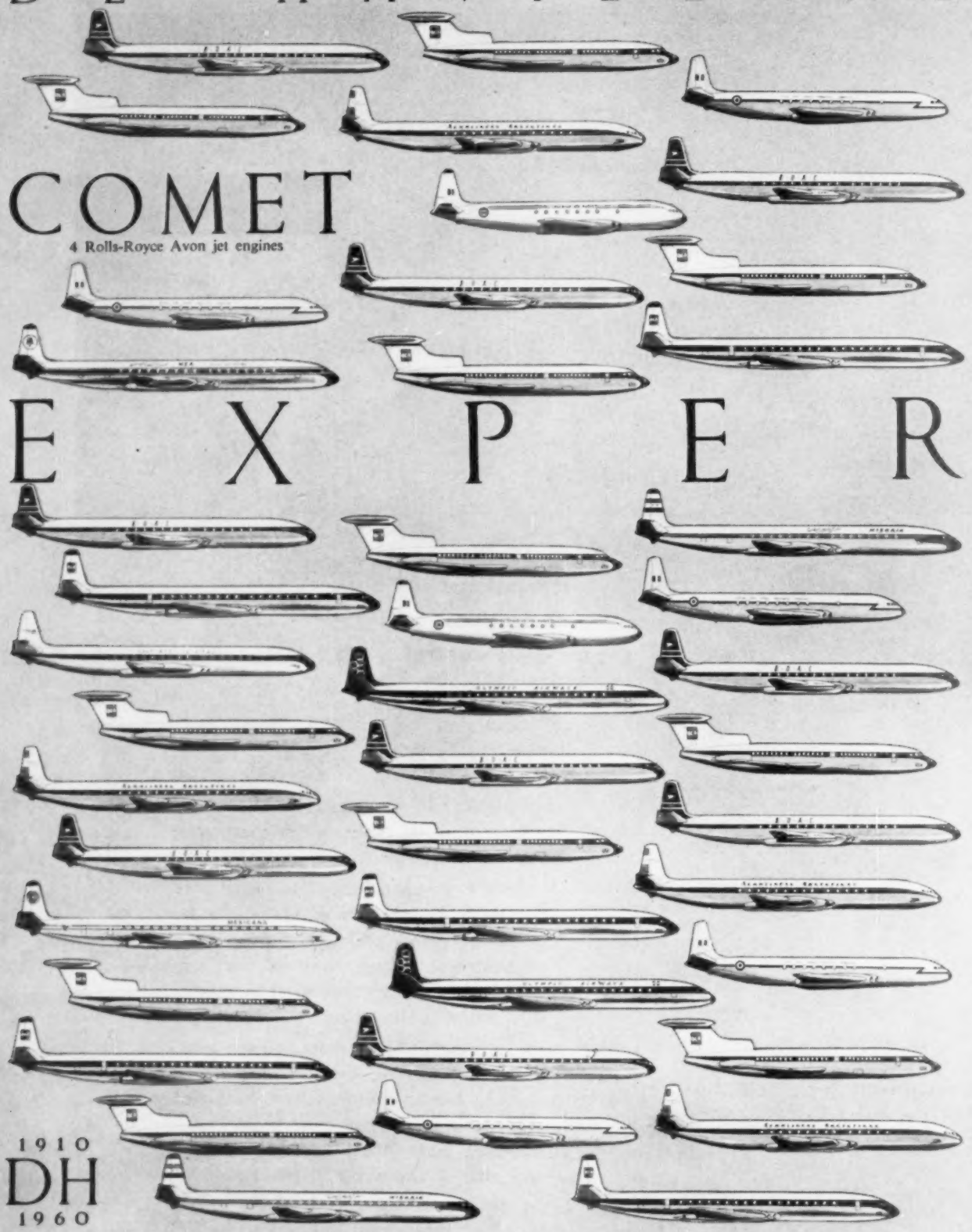


COMET

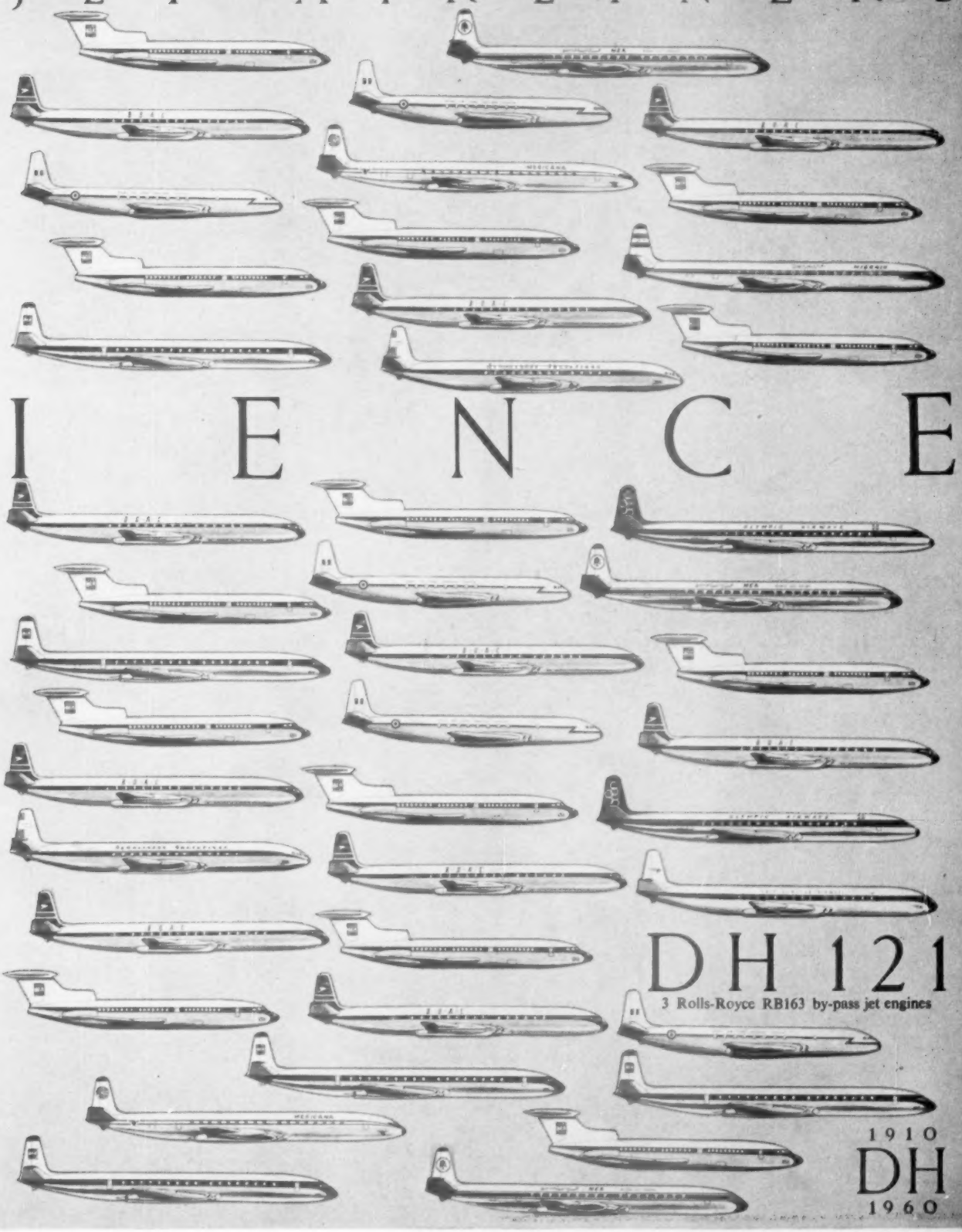
4 Rolls-Royce Avon jet engines

EXPER

1910
DH
1960

D'H AIRCRAFT · D'H ENGINES · D'H PROPELLERS · D'H AUSTRALIA · D'H NEW ZEALAND · D'H SOUTH AFRICA · D'H CANADA · D'H USA

JET AIRLINERS



IENCE

DH 121

3 Rolls-Royce RB163 by-pass jet engines

1910
DH
1960

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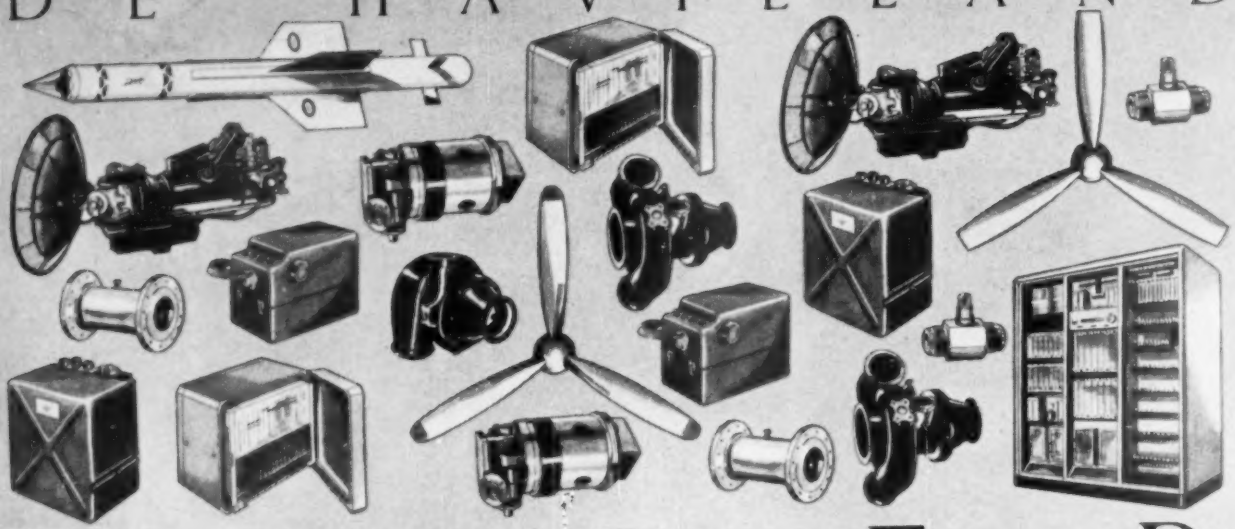
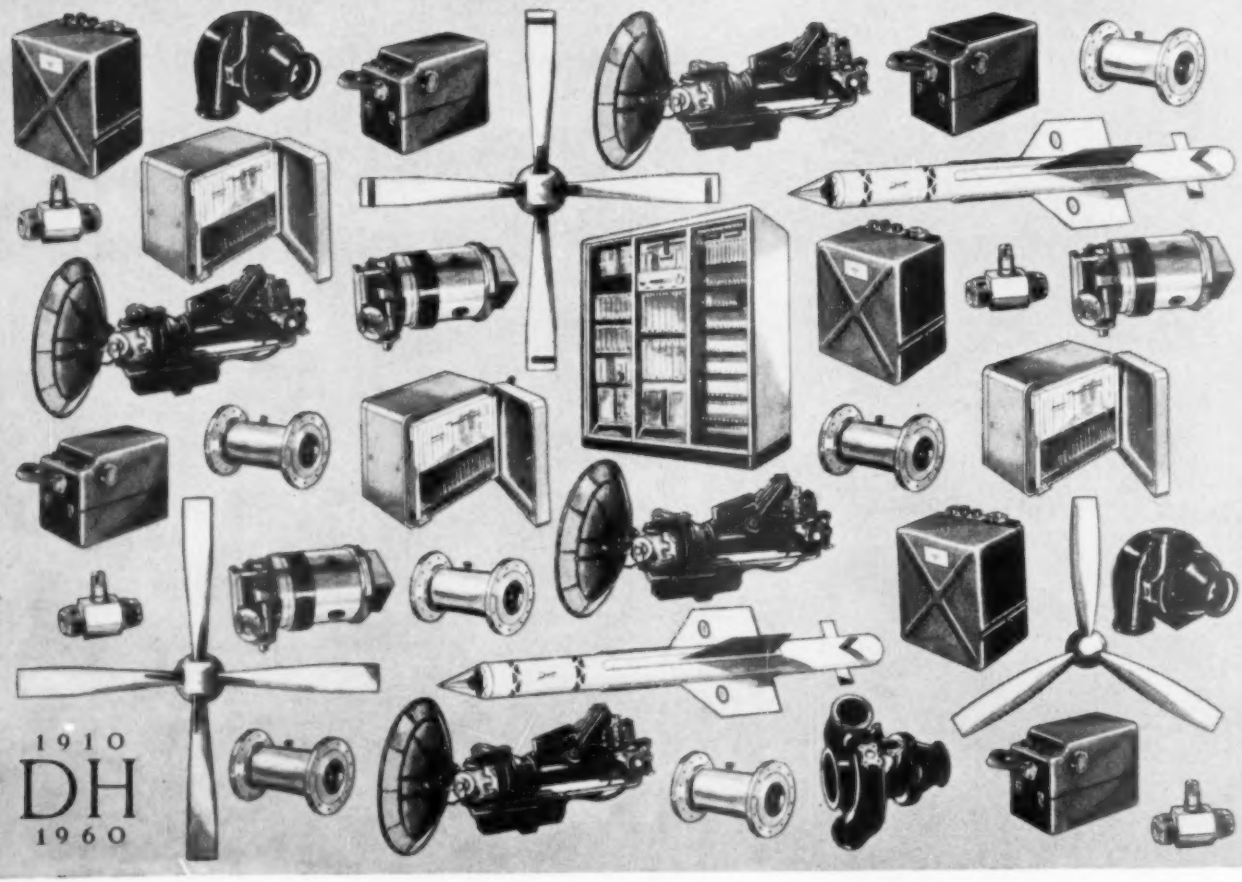


EXPER

MISSILES PROPELLERS ELECTRONICS FLOWMETERS
ALTERNATORS ENGINE CONTROL SYSTEMS



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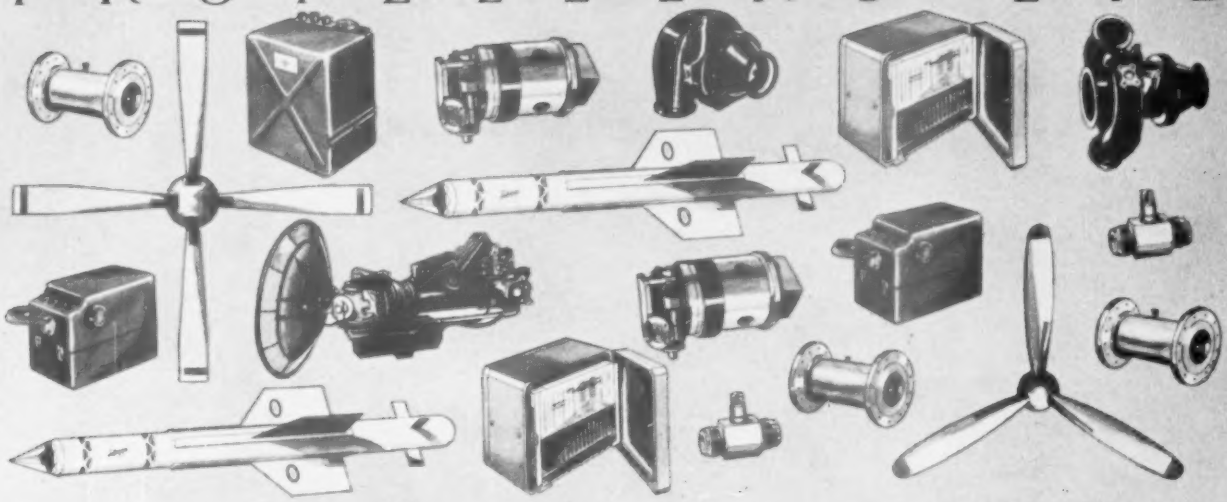
AIRCRAFT ENGINES PROPELLERS AUSTRALIA NEW ZEALAND SOUTH AFRICA CANADA USA

PROPELLERS LTD

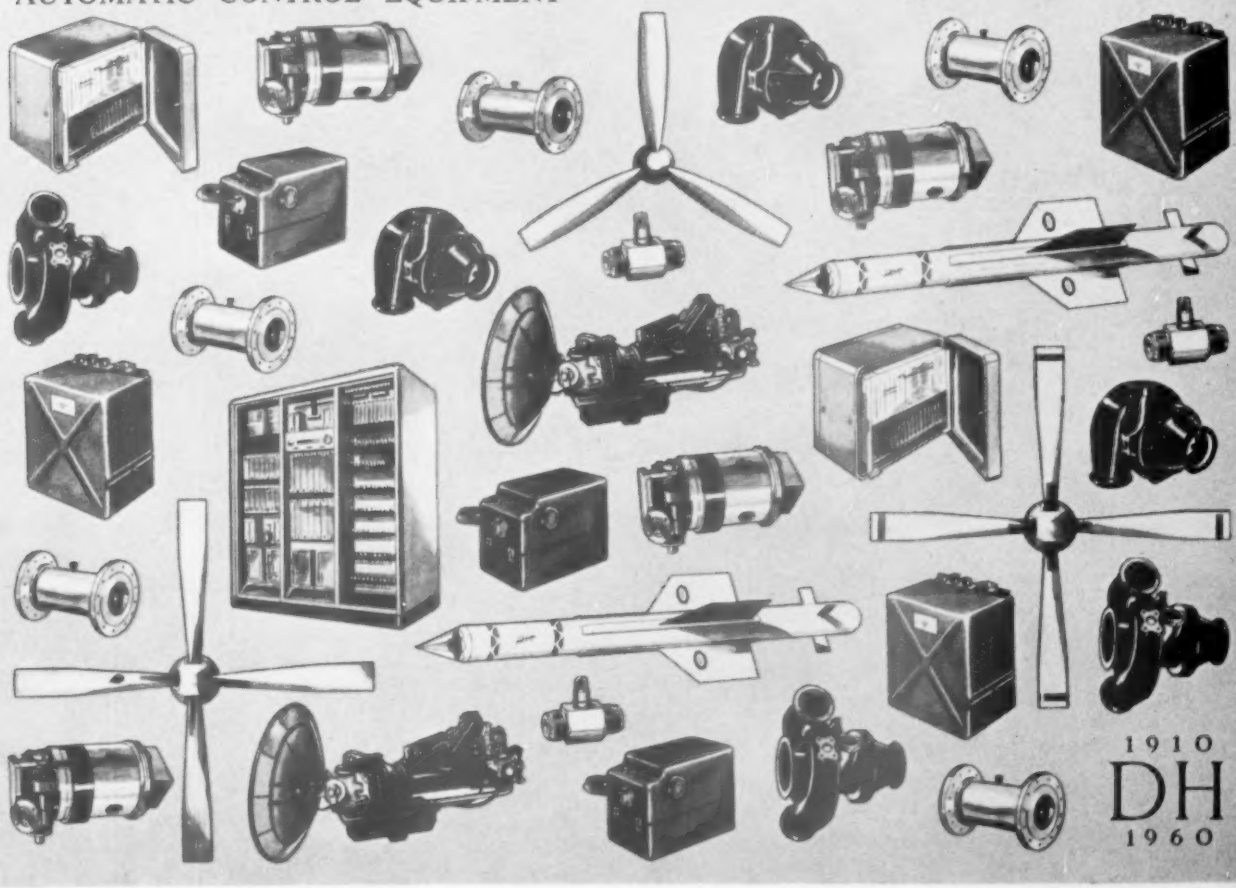


I E N C E

AIR-CONDITIONING SYSTEMS
AUTOMATIC CONTROL EQUIPMENT

RADAR SCANNERS

PLASTICS



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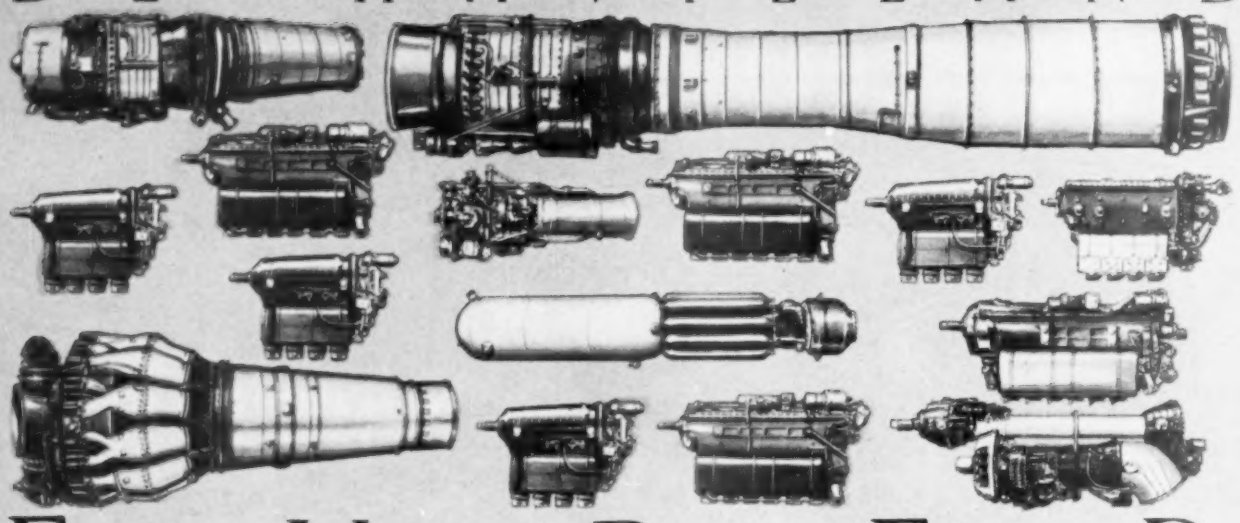
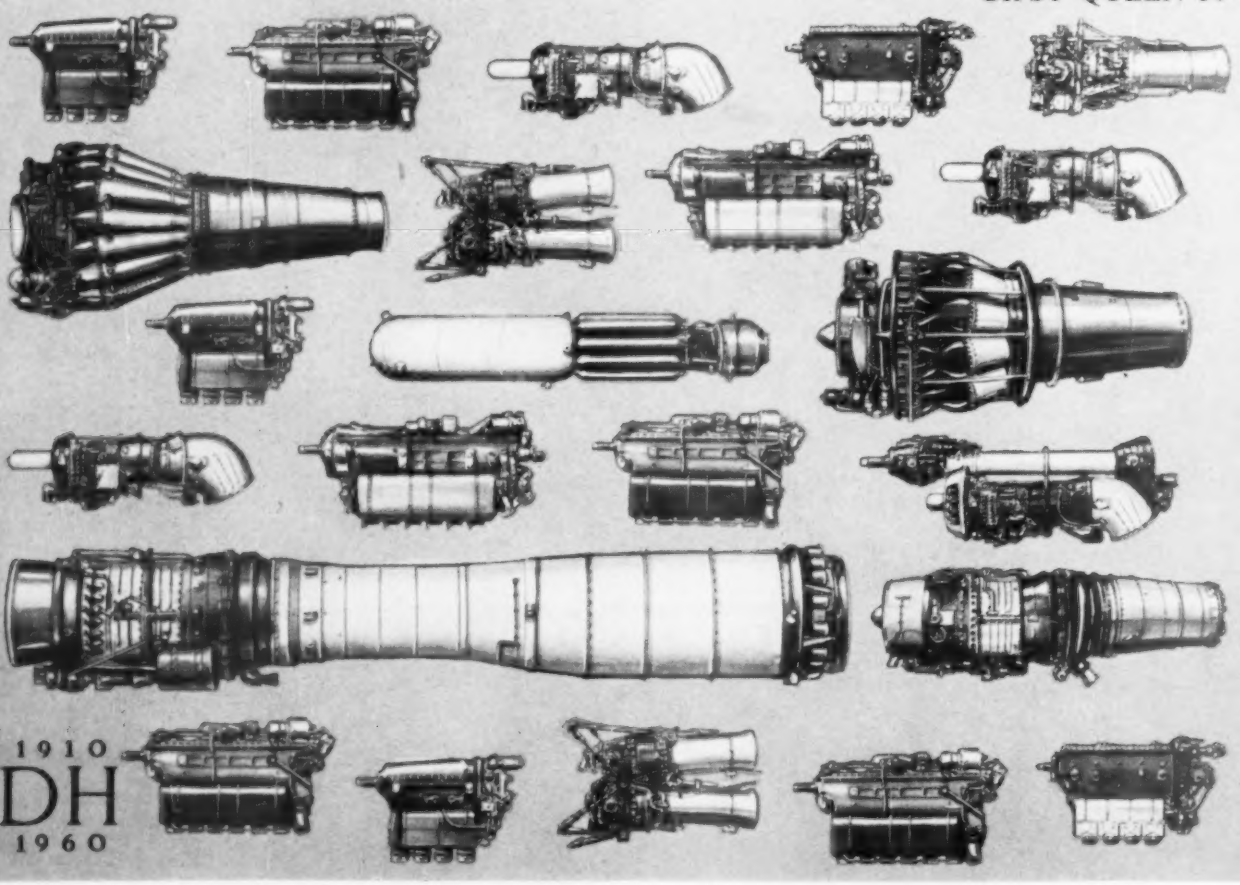


EXPER

GOBLIN GHOST GYRON JUNIOR GNOME DOUBLE SPECTRE
GIPSY QUEEN 30



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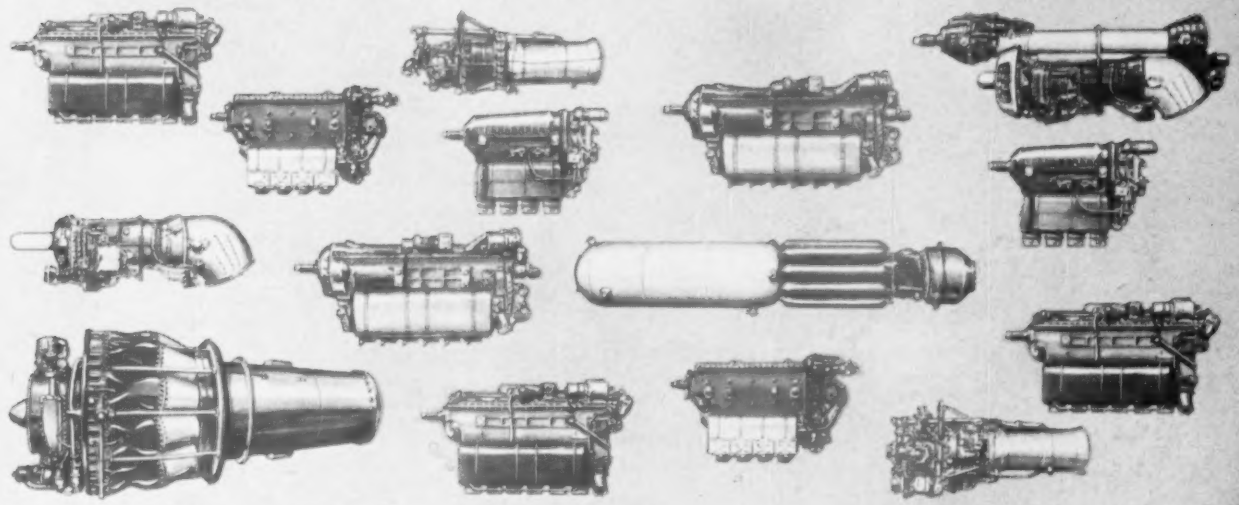
ENGINES



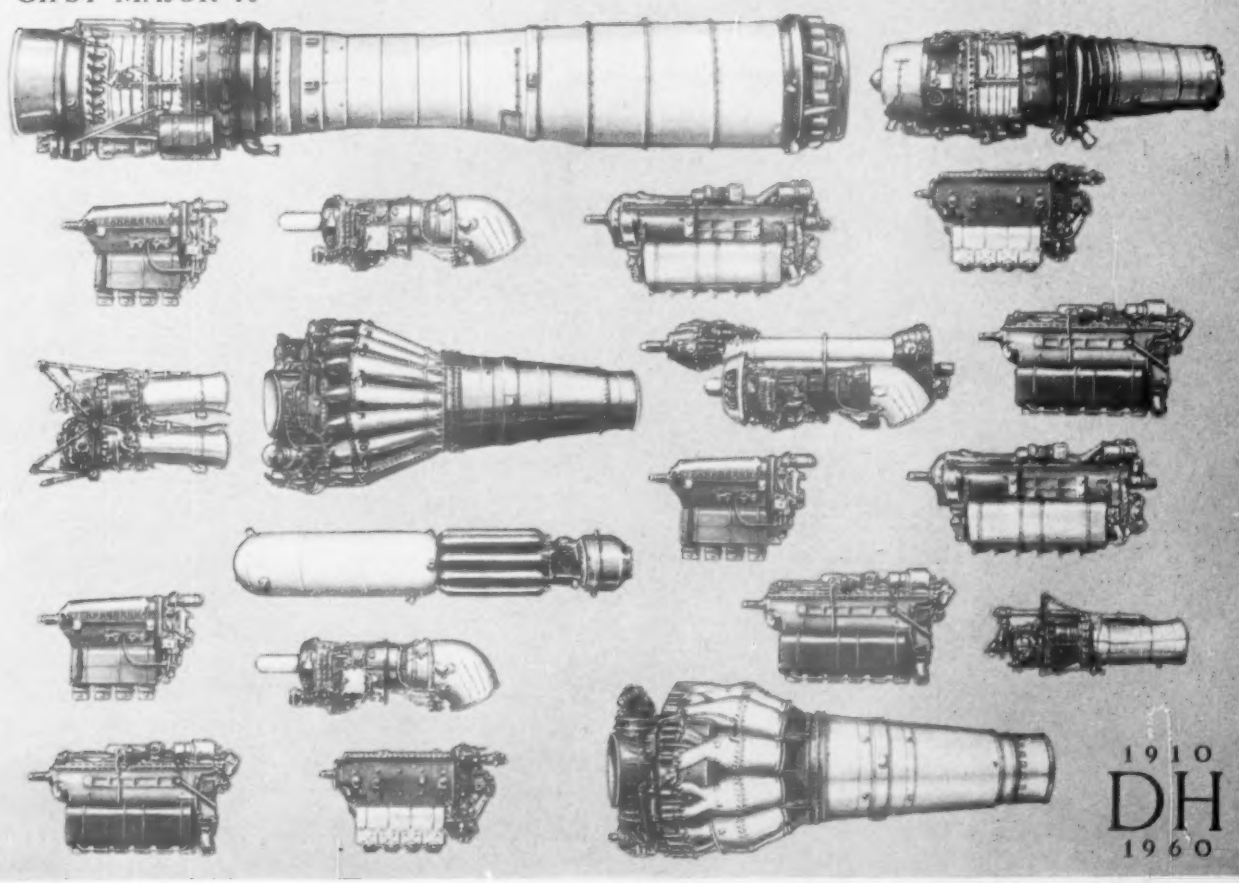
I E N C E

SUPER SPRITE
GIPSY MAJOR 10

SPECTRE

GIPSY MAJOR 215

GIPSY QUEEN 70



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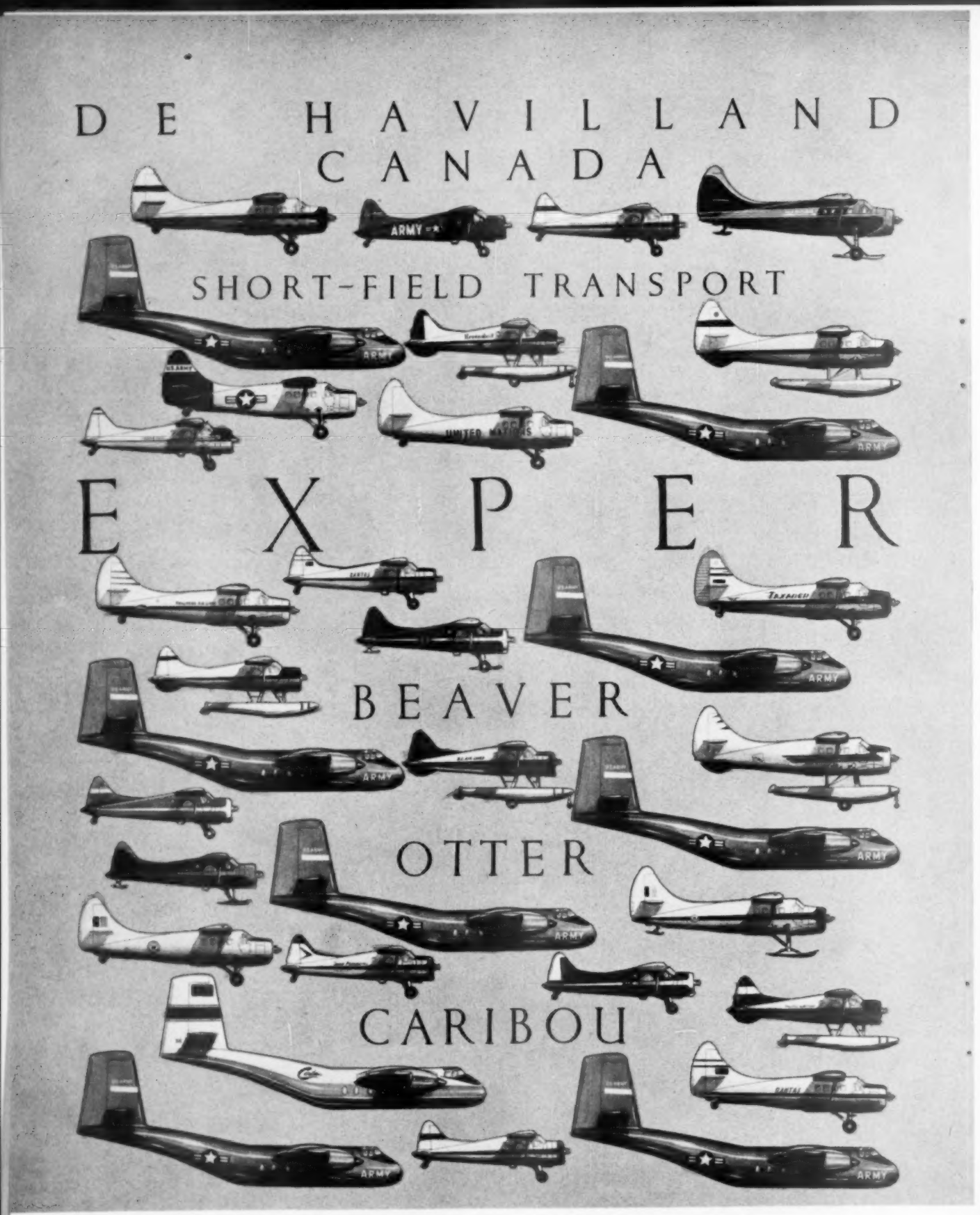
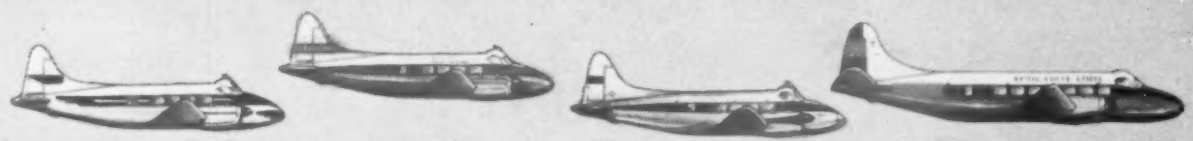
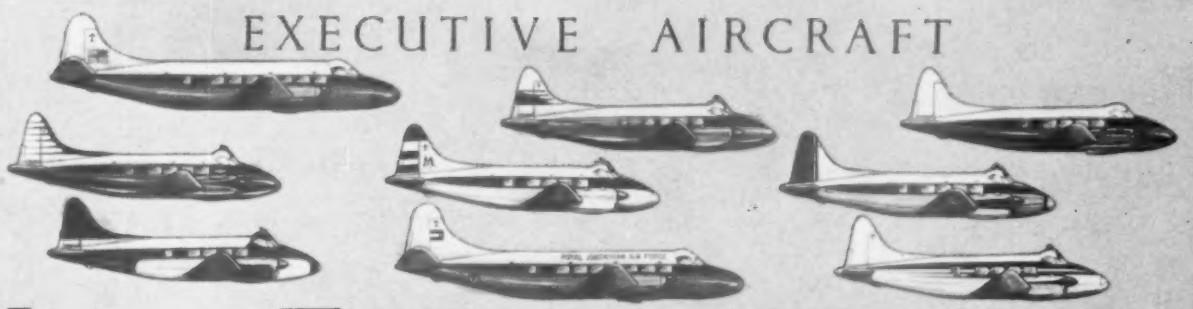

DE HAVILLAND
CANADA
SHORT-FIELD TRANSPORT
EXPER
BEAVER
OTTER
CARIBOU
ARMY
AIRCRAFT
ENGINES
PROPELLERS
AUSTRALIA
NEW ZEALAND
SOUTH AFRICA
CANADA
USA

DE HAVILLAND



EXECUTIVE AIRCRAFT



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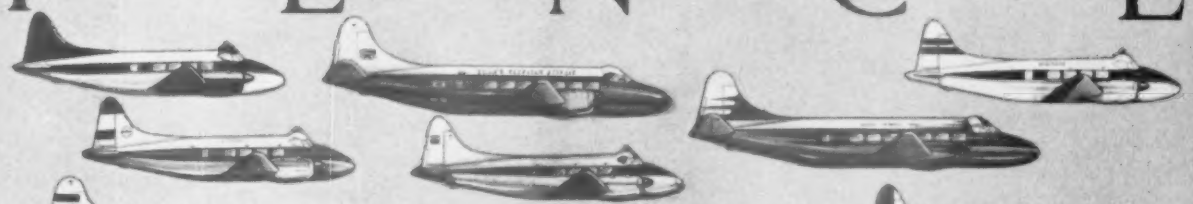

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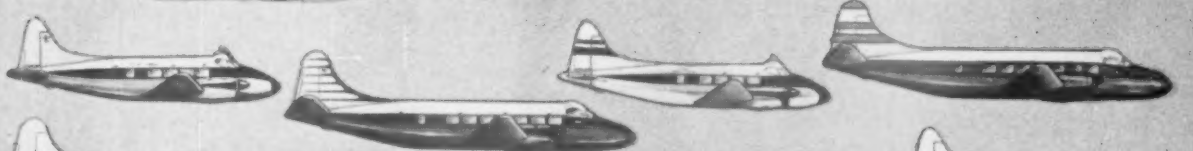

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Aircraft can always get off to a good start with the aid of a Murex Ground Power Unit. These diesel engine-driven equipments are designed to supply instant and reliable power for the starting and servicing of a wide range of piston, turbo jet and turbo prop aircraft and they are used by leading operators and manufacturers throughout the world. Special models can be supplied to meet individual requirements, but standard equipments are designed to provide a peak load of 2,000 amperes for engine starting and a current of 600 amperes continuously at 28 volts for servicing and preflight checks. Please write for full details.

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Guide to the Static Displays . . . .

(*Continued from page 326*)

Saunders Valve Co., Ltd. (220). Examples of the company's latest developments in aircraft fluid control, including Mk. 4 spherical plug valves, both manual and motorized models; a flap-type non-return valve; and non-return valves for special fluids.

W. Bryan Savage, Ltd. (243). On show is the company's latest vibrator—the Type V1003—together with a control console. The G.4g meter and Type O2 oscillator are also exhibited.

The Schermuly Pistol Rocket Apparatus, Ltd. (62). Exhibits include a wide range of aeronautical pyrotechnic stores, including airfield location signals; ground warning flares, high altitude parachute illuminating flares, signal cartridges and pistols, helicopter and light aircraft emergency landing flares, dinghy distress signals, etc. Among the items of special interest are a 12-lb. grapnel rocket line-thrower, and a combined red flare and orange day and night smoke signal.

Sciaky Electric Welding Machines, Ltd. (31). New developments in the field of resistance welding of particular interest to aircraft manufacturers are shown. These include heavy spot-welded aluminium sections and a new type all-welded high-temperature sandwich structure. Many other samples of aircraft and missile welding may also be seen on this stand.

Tom M. Scotney, Ltd. (101). Exhibits include models of stackable cradles for the storage and inter-factory movement of aero-engines and other major assemblies. Also shown are various types of containers, mobile transit stands and examples of pre-packaging for the Services.

Scottish Aviation, Ltd. (E). Illustrations and paintings of the Twin Pioneer.

Serck Radiators, Ltd. (277). Oil-coolers for a variety of aircraft, using air- and fuel-flow cooling.

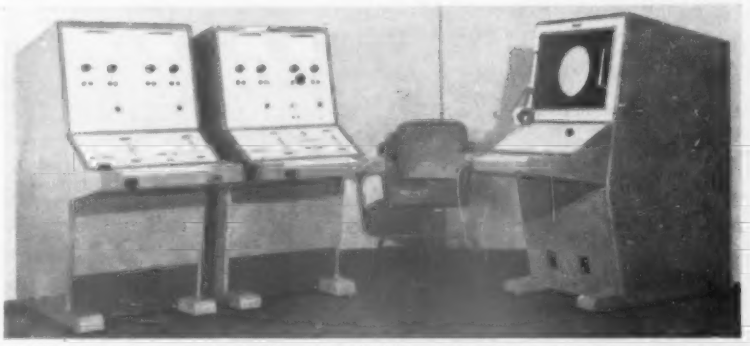
Sheffield Smelting Co., Ltd. (242). An up-to-date range of all types of electrical contacts and contact assemblies; special silver solders for individual aircraft manufacturers.

Shell-Mex and B.P., Ltd. (211–212). The Shell and B.P. Aviation Services stand represents the Shell International Petroleum Co., Ltd., B.P. Trading, Ltd., and Shell-Mex and B.P., Ltd. Photographs of fuelling equipment at London Airport are on display.

Short Brothers and Harland, Ltd. (59 and O.D.S. L). Models of VTOL strike and supersonic transport aircraft, and 1/24th scale model of SC.7 light freighter, together with full-scale section of the aircraft's fuselage. Also 1/24th Britannic, and Seacat and Tigercat short-range ship-to-air guided missiles. In the missile park is a multiple launcher with four Seacat missiles.

Siebe, Gorman and Co., Ltd. (144). A new pattern closed-circuit oxygen breathing apparatus contained in a glass-fibre case and worn on the chest, is shown. This was developed for crews' emergency use in Comets of B.O.A.C. and B.E.A. A new pattern fire-fighting suit is made from a heat reflective material recently introduced from America. A lightweight, portable air compressor weighing 65 lb., designed for charging air cylinders for breathing apparatus is also exhibited.

A brushless Plessey AC generator for the V.C.10. It is rated at 40 kVA at 6,000 r.p.m.

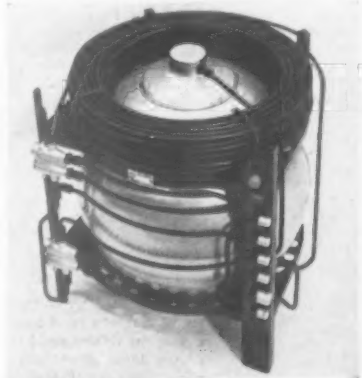


The Redifon four target simulator intended for the *ab initio* and advanced training of A.T.C. personnel.

Simmonds Aerocessories, Ltd. (180 and O.D.S. S). New products shown comprise Pacitor gauge for liquid oxygen, and Simmonds aviation fuel and lubricating oil dispenser vehicles. For the first time at Farnborough are an F.C. miniature potentiometric recorder, and F.C. transistor frequency meter (tachometer), spire screw caps, quick release strainers, fabricated strainers, shock alleviators, and solenoid-operated stop valve.

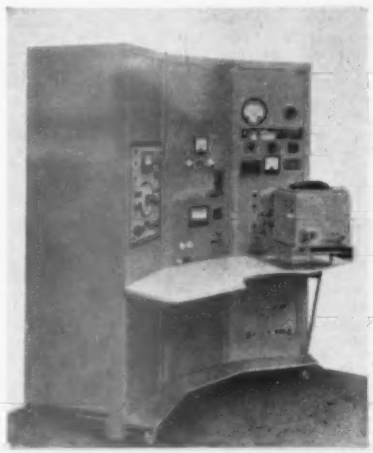
Skyhi, Ltd. (169). Exhibits include a 40-ton capacity hydraulic tripod wing jack, fitted with an air-operated motor. This jack is for lifting heavy commercial and military aircraft and embodies all the usual features, such as screwed rams with safety locking collar; spring-loaded castoring equipment; screwed extension; overload valve, and also has a hand pump for manual operation. A further development will be of at least 50-tons capacity to cater for future aircraft. A range of hydraulic wheel change jacks of varying capacities and heights are shown.

Smart and Brown (Machine Tools), Ltd. (102). This company has been appointed sole U.K. licensees of the Deutsch Company of Banning, Calif., which manufactures a range of miniature crimped connectors. These are being shown at Farnborough, together with aluminium plugs and sockets, and coaxial connectors.



A Normalair 30-litre liquid oxygen converter for the V.C.10.

Smiths Aviation Division embracing **Smiths Aircraft Instruments, Ltd.** (2), **Kelvin and Hughes (Aviation), Ltd.** (3 and O.D.S. 16), **Waymouth Gauges and Instruments, Ltd.** (4) and **K.L.G. Sparking Plugs, Ltd.** (1). Main attraction of the exhibits is the revolutionary Smiths para-visual flight director system which provides pilots with computed director intelligence through the mechanism of non-fixated vision. The latest range of auto-pilots is also on display, and includes the SEP2, the SEP4 (with built-in landing facility), and Multiplex SEP5 for the regular auto-landing of the D.H.121. Smiths Flight Systems comprise the S.F.S. Type 1, for the Comet, Britannia, Argosy and Vanguard, and the simplified Type 4. Other exhibits include a 100,000-ft. servo altimeter, a JPT indicator, cooling air failure warning units, engine control systems, high-energy igniters, thermocouples and harness, bearing movement indicator connector, and many other accessory items. In the outside display are a Kelvin Hughes rapid processing projector and equipment.



The W. Bryan Savage Type V 1003 vibrator together with a control console. The latest in the company's range, it has an 18 in. dia. table and a nominal peak thrust of 1,750 lb.

Smith's Stamping Works (Coventry), Ltd. (34). This exhibit consists of a range of examples of drop forgings for airframe and engine components with particular emphasis on turbine discs and compressor wheels in heat resisting and stainless steels, and special materials such as Nimonic and titanium alloys.

Solartron Electronic Group, Ltd. (164). A feature of the Solartron stand is a photographic background showing the company's data processing equipment, air-to-ground, ground-to-air, air-to-water radar simulators for the training of radar and flight personnel, and for research into radar systems, plus other Solartron electronic products. These include an oscillator and an oscilloscope, voltmeters and a generator, and digital data-handling equipment.

Solus-Schall, Ltd. (249). Magnaflux and Zyglo crack-detection units; Eresco portable X-ray unit; and associated equipment.

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Southern Forge, Ltd. (258). Producers of bars, rods, sections, tubes, forgings and stampings in Alminal aluminium alloys.

Southern Instruments, Ltd. (153). Electronic apparatus including trace readers, pre-amplifiers for transducers, oscilloscopes, and a recording camera.

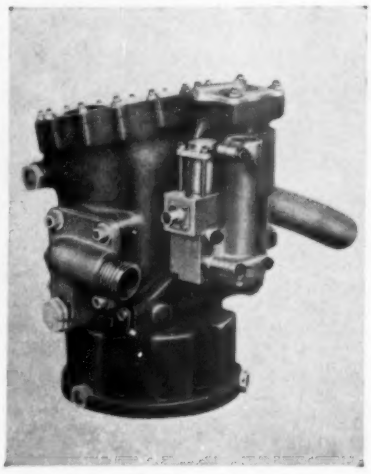
Sparklets, Ltd. (201). Producers of dinghies and life-jacket inflation mechanism; aluminium pressure die-castings; woven wire braiding.

S.P.E. Co., Ltd. (168). Are exhibiting a full range of fuel pumps including those fitted to Viscount, Vanguard, Comet, Britannia, Argosy, Avro 748 and VC10. Representative turbine-driven in-flight refuelling pumps and pumps for methanol/water injection, H.T.P. fuel and aircraft water systems are displayed, together with fuel system recuperators, float level control valves, non-return valves, and cabin heater system pumps. A complete range of Flylite flexible fuel hose assemblies, together with couplings and end fittings will also be exhibited.

George Spencer Moulton and Co., Ltd. (184). The following items are featured: products in especially compounded Elastometers for high temperature service, anti-vibration and shock-absorbing units, Avocel expanded P.V.C. for packing application, rubber seals, resilient drive shaft couplings, and Flexitor suspension units.

Sperry Gyroscope Co., Ltd. (90). New developments illustrated by examples, rather than by complete sets of current products. Company's activities not confined to the "conventional" Sperry fields of gyro instrumentation and control, but extend to hydraulics, turbine engine performance monitoring, synchros and other specialized electro-mechanical components, and now to the automatic control of production machine tools and similar apparatus. New instrument developments exemplified by a British-made "Rotorace" directional gyro, which has been in production for some months for military and civil operators. A new range of fixed-angle variable-delivery pumps, hydraulic pumps, and motors, a vibration sensing and analysing system, and further new items.

Standard Telephones and Cables, Ltd. (146–149). Principal exhibit this year is the new automatic DF triangulation equipment, type PVT–2, which uses television techniques. In association with networks of automatic ground-based wide-aperture DF stations, the new equipment provides an accurate and convenient aircraft position finder for use in ATC. STRAD high-speed electronic switching system and data processing equipment is also shown, together with STC airborne communication and navigation equipment. This includes VHF/ILS/VOR/MARKER instruments; the STR–40 radio altimeter for automatic landing; ILS/VOR tests sets; a localizer transmitter and remote control unit for STC ILS; and various STC components.

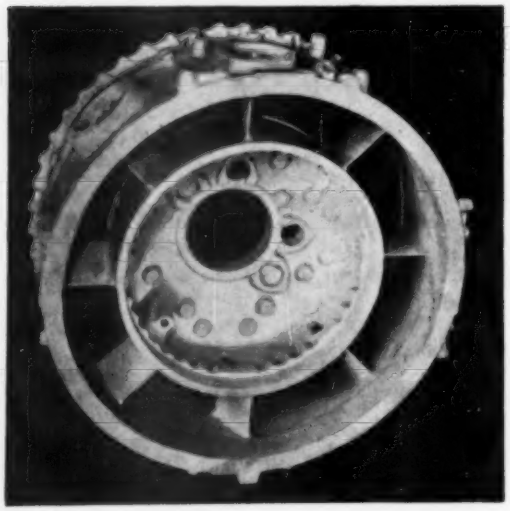


Manufactured by Sperry, this 0-15 g.p.m. Vickers variable-delivery pump is of the type specified for the V.C.10. Similar pumps are to be used in the D.H.121.

Steel, Peech and Tozer, Ltd. (135). See Samuel Fox and Co., Ltd.

Sterling Metals, Ltd. (5). Major exhibits comprise sand castings of the Bristol Siddeley Olympus intermediate casing, Napier Eland support plate, Fairey Rotodyne windscreen frame, Dunlop Viscount landing wheel hub, de Havilland Comet 4 twin boost casing, D.H. Sea Vixen pylon casting, and a Bristol Siddeley Proteus air intake casing. Die and precision mould castings include a comprehensive collection of smaller units in aluminium and magnesium alloys.

J. Stone and Co. (Charlton), Ltd. (8). Range of sand and gravity die castings in aluminium and magnesium alloys as used by the main aircraft components manufacturers. Prominent in this section will be a group of castings made in M.S.R. magnesium alloys, which have high proof stresses claimed to exceed those of any other magnesium alloy. There is also a group of precision castings in aluminium, magnesium, and copper base materials, to illustrate the plaster core, Shaw process, and shell moulding methods of manufacture.



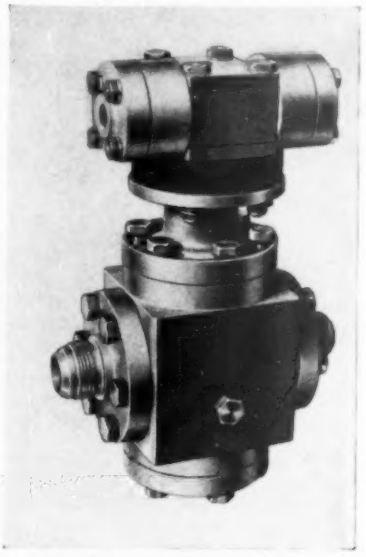
A Bristol Siddeley Olympus intermediate casing manufactured in magnesium zirconium alloy by Sterling Metals.

J. Stone and Co. (Deptford), Ltd. (9). Various types of light alloy and other non-ferrous rivets, washers and other fasteners produced for the aircraft industry, and automatic voltage regulators of the sealed type. Also exhibited are Stone-Vapor thermostatic temperature controls and relays, as used on the Viscount, Vanguard and Argosy. These products are designed for use in connection with cabin temperature control, duct over-heat control, and engine and wing de-icing systems.

Suntex Safety Glass Industries, Ltd. (54). Manufacturers of Perspex cabin windows; canopy mouldings; bullet-proof glass windscreens; rigid P.V.C. moulded panels; and clear acrylic tubing.

Super Oil Seals and Gaskets, Ltd. (55). A representative selection from its comprehensive range of SuPerfect oil and grease retainers, hydraulic packings and rubber mouldings; also Aeroquip flexible hose with re-usable fittings for low, medium and high pressure hydraulic, pneumatic and fuel systems. Special interest is centred on the type 666 high temperature polymer hose assemblies with polytetrafluoroethylene lining currently supplied to Rolls-Royce, Ltd., for the Conway Mk. 5 engines fitted to the Boeing 707/420 aircraft for B.O.A.C., Deutsche Lufthansa A.G. and Air India International; also the type 601 lightweight synthetic rubber hose supplied to Rolls-Royce, Ltd., for the same application.

Taylor, Taylor and Hobson, Ltd. (76). Precision measuring equipment shown includes the Talyrond Model 50 roundness gauge, the Talysurf Models 3, 100 and 101, surface measuring instruments, the Magna-Gage Mk. II electronic comparator and signal light indicator, and the Talyvel electronic level.



Designed for use with liquid oxygen, this valve is based on the Saunders Valve spherical plug design and fitted with a compressed-air motor.

Tecalemit, Ltd. (179 and O.D.S. K). At the indoor exhibition is a recently introduced range of Tecalemit high pressure nylon flexible hose, of ⅛ in. to ½ in. bore; ribbon filter elements designed to filter air, fuels, hydraulic and lubricating oils down to particle size of approximately 40 microns with high rates of flow, available from ¼ in. to 6 in. diameter are also exhibited. A range of Waveflex, flexible and twistable waveguides for use in connection with microwave transmission in radar communication systems, made by subsidiary company, Gabriel Manufacturing Co., Ltd., Torquay, will be seen. Outside are examples of fire-fighting equipment manufactured by Foamite, Ltd., another subsidiary company.

Technograph Electronic Products, Ltd. (151). A comprehensive range of printed circuits is being shown by this company, on its first appearance at Farnborough, for de-icing elements, plated-through hole circuits, tape cables, thermocouples and sensing elements, strain gauges, flush-bonded circuits, switches, inductors, resistors and chemical milling.

Teddington Aircraft Controls, Ltd. (41). On display are components of cabin temperature control systems; ice warning and wing, tail and engine de-icing equipment; fuel tank pressurization systems; missile heating control and gate valves.

Teleflex Products, Ltd. (86). This company is exhibiting examples of its range of flying controls equipment, including cable tension regulators, lightweight pulleys, roller fairleads, pressure seals and trim jacks. Also shown is its inertia-lock crew harness which now has full A.R.B. approval for 25*g* installations. Teleflex Pacific cable tension regulators are specified for practically every new aircraft including the Avro 748, A.W. Argosy, Vickers VC10, Britannic, Blackburn NA39, Sea Vixen, etc.

Thermal Control Co., Ltd. (173). Makers of Firetec aircraft fire-detection equipment and various pressure-operated switches for fuel systems and hydraulic systems.

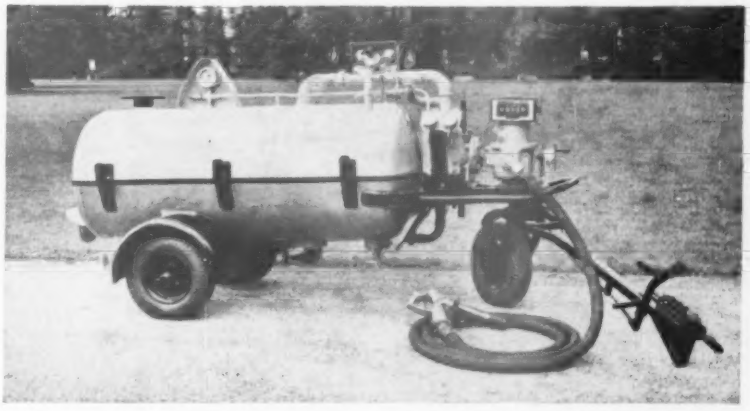
Thermionic Products (Electronics), Ltd. (278). The Thermionic multi-channel recorder, Mark VI and the B.C.C. multi-channel automatic recording system (MARS). A range of VHF communications equipment manufactured by British Communications Corporation, Ltd.

Thorn Electrical Industries, Ltd. (132). Manufacturers of Plastek panels and other flight-deck illumination systems; range of passenger-facility panels, roof cabin lights and warning signs; electrical connectors and other units.

Titanine, Ltd. (197). This company is showing aircraft finishes approved to current requirements with special reference to new developments in protective coatings for exterior and interior painting of aircraft and aircraft equipment. Special exhibits deal with the latest Titanine scheme T.T.16 for advance requirements of all-in protection on pressurized aircraft.

T.K.S. (Aircraft De-Icing), Ltd. (17). The main exhibit consists of a T.K.S. fluid de-icing system, comprising the switch, suppressor and wiring to pump motor; tank with pump attached; flexible outlet pipe from pump to micro-filter, from which nylon main, gallery and branch pipes lead to a sectioned panel distributor. Items not previously exhibited include distributor with the new Porosint Rigimesh porous stainless steel panel, and a nylon pipeline system.

The new Standard Telephones and Cables automatic DF triangulation system. It comprises a bearing simulator (lower front cabinet), a sweep generator, a picture synthesizer, and two television picture monitors.



The Mersey 100-gal. lubricating oil dispenser originally developed for Shell by Truro Engine Works.

Triplex Safety Glass Co., Ltd. (6). Main feature is a prototype E.E. Lightning windscreen with Triplex gold-film heating, shown working in refrigerated conditions. Vanguard, Comet and Hunter de-misting windscreen sections are also being shown, together with silicone interlayered screens for use with very high speed aircraft under frictional heat.

Ronald Trist and Co., Ltd. (64). Selection of rubber materials and seals to meet requirements of all sections of the aircraft industry. Nitrile rubber compounds have been developed to give maximum resistance to high and low temperatures, compatibility with mineral base hydraulic fluids and lubricants, fuels, and with good physical properties. Viton the new fluorinated Elastomer combines outstanding fluid resistance with serviceability at extremely high temperatures. Butyl rubbers have been specially compounded and have been used with marked success in equipment handling Skydrol 500 and 7000 ester base non-inflammable hydraulic fluids.

The Trix Electrical Co., Ltd. (77). Producers of sound amplification equipment of various types for ground and airborne use.

Truro Engine Works, Ltd. (O.D.S. I). On show is a 60 Imp. gal. hand-operated lubricating oil dispenser on a four-wheel chassis, as supplied to Shell-Mex and B.P., Ltd., and a 100 gal. oil dispenser originally developed for Shell International Petroleum Co., Ltd. There is also a 600 I.g.p.m. hydrant main dispenser on a Bedford chassis, ordered by English Electric Aviation, Ltd. and Vickers-Armstrongs, Ltd.

Tubes, Ltd. (241). Tubular or hollow forgings for compressor and turbine shafts, helicopter main rotor shafts, transmission and propeller shafts, landing gear, actuator cylinders and rocket motors.

The Tungum Co., Ltd. (263). Manufacturers of components for guided weapons and radar equipment; springs, spinnings and machined parts.

Turner Brothers Asbestos Co., Ltd. (32). Aircraft and guided weapons components moulded in either Durestos resinated asbestos material or Duraglas glass-fibre reinforcement. Durestos felt for mouldings with large surface areas is widely used for surveillance scanners, drop tanks, fairings, nose cones and many other aircraft and missile parts. Durestos flocks and powder provide for production of smallest and most intricate shapes. Included in the Duraglas range are A.I.D. approved finished cloths and tapes together with powder and emulsion bound chopped strand mats supplied under the trade name Duramat.

Turner Manufacturing Co., Ltd. (133). Manufacturers of oleo compression legs; jacks, retracting mechanisms; vacuum and hydraulic pumps; flying controls.

Ultra Electronics, Ltd. (275). Exhibits on display include push-button communication control, an engine vibration indicator, condition analyser, and control equipment and SARAH search, rescue and homing apparatus.

This new Kelvin Hughes 100,000 ft. servo altimeter can be seen in the Smiths Aviation Division display.

Unbrako Socket Screw Co., Ltd. (259). This company's new advanced design division is developing and manufacturing high performance bolts and fasteners for the aerospace and kindred industries: fasteners are available in a variety of materials, including titanium, and in almost any configuration.

Vactric (Control Equipment), Ltd. (183) and **Vactric (Precision Tools), Ltd.** (182). Range of international frame size precision servo components including AC motors and motor tachogenerators as well as DC motors, both permanent magnet, split-field and tachogenerators. In-line gearheads with ratios of up to 1000:1 will also be featured. Recent developments in the application of high speed rotary switches. Comprehensive display of breadboard servo components and speed reducer kits. An actuator is shown working in an oven temperature of 200°C. minimum and controlled by a simple positioning servo.

Valay Industries, Ltd. (104). Aircraft cleaning products, including Aerowax high-gloss protection, Aerowash wash-down additive, Aeroval interior cleaner, Wadpol polish.

Guide to the Static Displays . . . .

L. M. Van Moppes and Sons (Diamond Tools), Ltd. (28). The new series 12 Diaform attachments are displayed, covering forms up to 4 in. × 1¼ in. on wheels up to 24 in. × 4 in., and designed for use on cylindrical, centreless and other grinders. Illustrations of the use of Diamesh roller truers in the production grinding of aircraft bearing components are also included. The Diatube range has been extended to include the hydraulic unit mounted on a Land Rover, for taking test cores in runways, and has been used at Farnborough.

Venner Accumulators, Ltd. (43). Examples from the Group's products developed for the aircraft industry include Venner accumulators, lightweight silver-zinc and silver-cadmium aircraft batteries in new easy-clean containers and Type HT125 hermetically sealed units for guided missiles and electronic equipment. Also exhibited are lightweight portable equipments utilizing Venner silver-zinc cells, battery chargers, automatic voltage control units as well as examples on one-shot energizers. Venner Electronics, Ltd., show examples of equipment incorporating the latest electronic techniques for test and development work in the aircraft industry. Venner, Ltd., show aircraft emergency lighting units, code senders and timing equipment.

Vernons Industries, Ltd. (13). Some 3,000 mobile AC and DC Vernon ground power units and energizers for aircraft are in use throughout the World. Items shown include static inverters and servicing and starting trolleys.

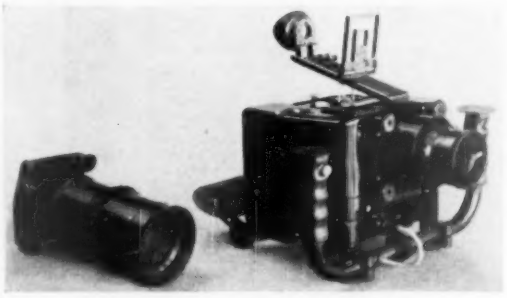
W. Vinten, Ltd. (124 and O.D.S. 13 and 14). Inside, this company is showing various still and ciné cameras for reconnaissance and scientific use, together with a 16 mm. combat recording camera. In the external exhibition is a photographic reconnaissance installation for small unmanned aircraft, and a P.R. system in a self-contained detachable pack for bomb-bay or wing installation.

W. S. Electronics (Production), Ltd. (160). Development, design, manufacture and repair of UHF and VHF airborne equipment, telemetry and other electronic equipment.

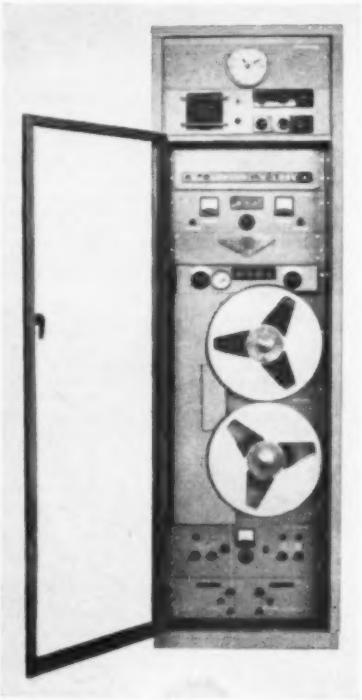
Ward, Brook and Co., Ltd. (207). Miscellaneous plastic, plastic/metal components including terminal blocks; personal life-saving apparatus; plastic extrusions; foam-rubber mouldings; injection mould tools.

Waymouth Gauges and Instruments, Ltd. (4). See Smiths Aircraft Instruments, Ltd.

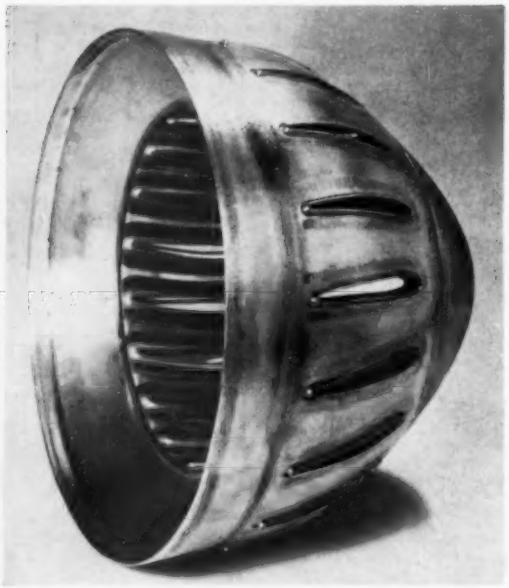
Wellworthy, Ltd. (139). A range of metallic sealing rings is on display, together with Spirolex retaining rings for securing shafts, gear trains, ball races and other internal and external circular components. Pistons and piston rings are also shown, plus the A1-Fin bimetallic bonding process and Wellseal jointing compound.



A new Vinten hand-held or fixed position camera for low altitude observation and reconnaissance photography.



A Thermionic Products (Electronics) standard bay Series 3 multichannel recording equipment.



A fabricated nose fairing in stainless steel manufactured by Wilmot Breeden for Rolls-Royce.

Western Manufacturing (Reading) Ltd. (217). Manufacturers of electrical actuators; trim and limit switches; warning indicators; thermostats; hydraulic and pneumatic valves and cylinders; high-temperature coils and sealed relays; pressings and stampings in light alloys; aircraft structures, sub-assemblies and components.

Westinghouse Brake and Signal Co., Ltd. (257). Comprehensive selection of the latest semi-conductor switching devices together with examples of their applications including three-phase static power inversion and AC power control. In addition, a selection of high power silicon rectifiers, available with inverse voltage ratings up to 1,000 volts, is shown, together with examples of complete assemblies. Also included is a selection of high temperature and miniature selenium rectifiers.

Westland Aircraft, Ltd. (J). Scale models of the very wide range of rotorcraft now encompassed by the Westland Group, including this year for the first time Bristol, Fairey and Saunders-Roe designs. The 25-ton 68-passenger SR-N2 Hovercraft, being built at Cowes, will also be shown in model form. Scenic groups illustrate four applications of the Twin Gnome Wessex, the P.531-2, the 192 and a Central London heliport.

Whitehouse Industries, Ltd. (136). The complete range of turret and industrial type Philidas all-metal one-piece self-locking nuts is displayed. Other exhibits include Philidas single and double anchor assembly nuts—standard, thin and countersunk types—and clinch nuts.

Whiteley Electrical Radio Co., Ltd. (206). Exhibits include a radio sonde, audio amplifiers and oscillators, aircraft cockpit knobs, plugs, sockets and microphones. Also on display is a range of specialized components encapsulated in epoxy resin and polythene including complete transistor audio amplifiers and oscillators together with a range of hermetically sealed pulse and miniature transformers and inductors.

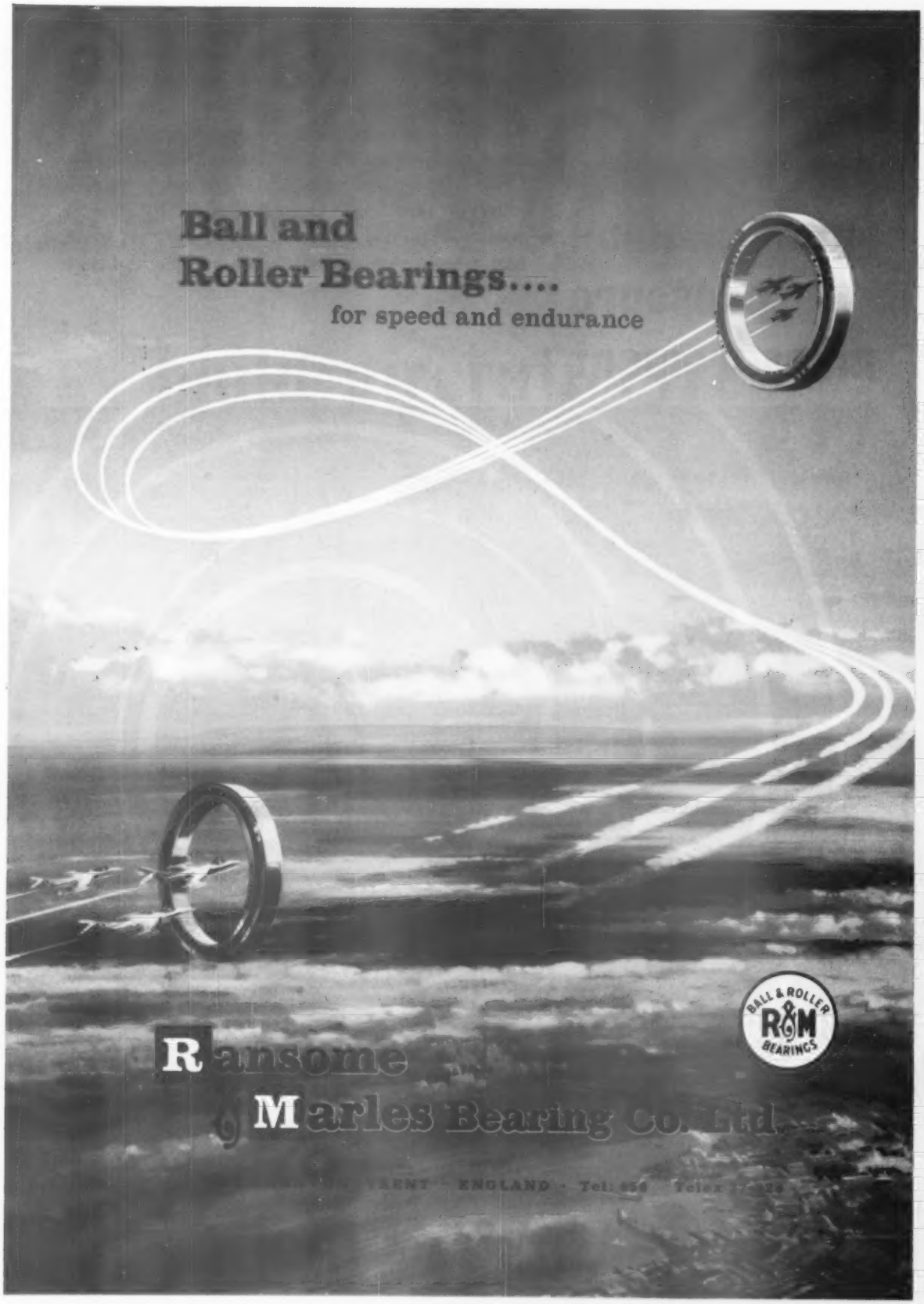
Henry Wiggin and Co., Ltd. (30). Emphasis is on the progress being made in the development of more advanced Nimonic alloys for operation at higher temperatures and on a number of important production improvements of significance to the gas-turbine industry. Comprehensive data are available on the Nimonic and Nimocast alloys.

Williamson Manufacturing Co., Ltd. (143). A selection of current photographic equipment for air survey and reconnaissance.

Wilmot Breeden, Ltd. (199). On display are hollow blades for Sapphire, Tyne and other gas turbines; fabrications in stainless steel and Nimonic 80A material alongside Argonarc welding and precision machining; the Wayne Kerr transfer function computer for the field of servo control system analysis; and the Telepak Size 5 hydraulic power supply.

Wireless Telephone Co., Ltd. (68). See the Plessey Co., Ltd.

Zwicky, Ltd. (250 and O.D.S. O). Inside, a 4-in. low-loss restrictor pressure controller, a shock alleviator, a 3-in. variable venturi, a slow-close nozzle, Uniplex and Biplex filters. Outside, the Severn 10,000 gal. refueller, the Angus superjet and Jetstream hydrant dispensers, and standpipe and loading arm.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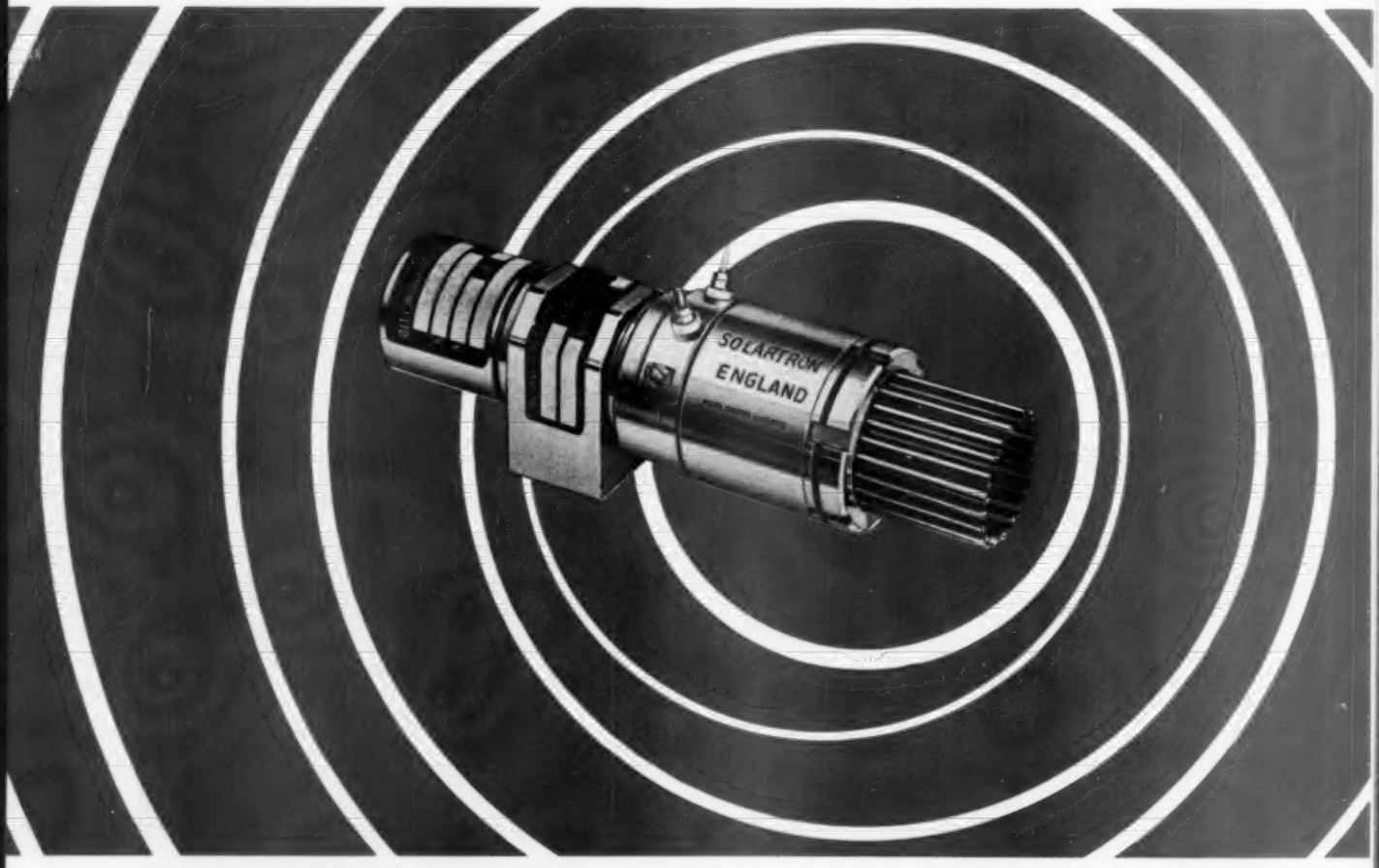

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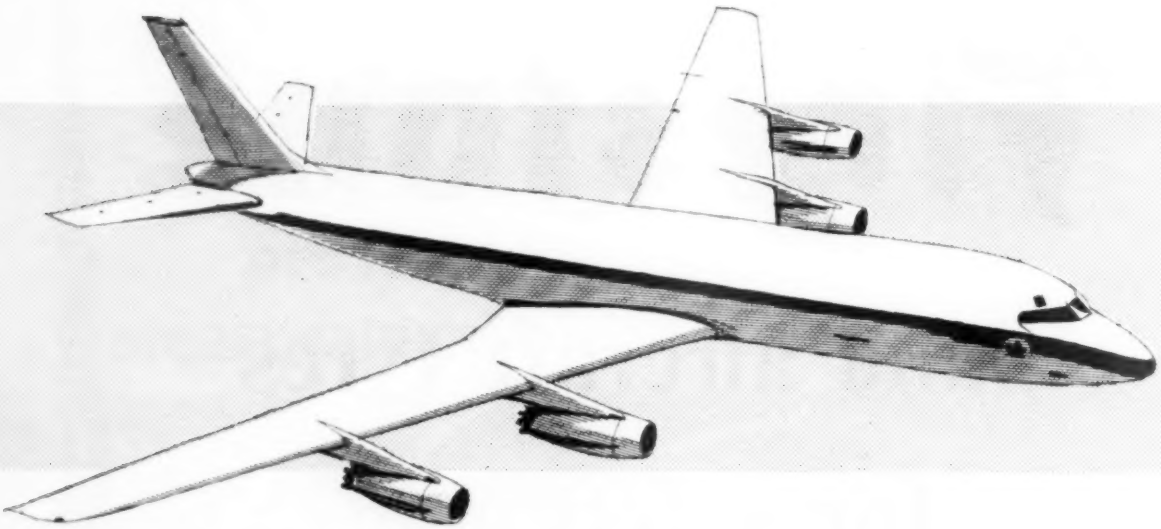

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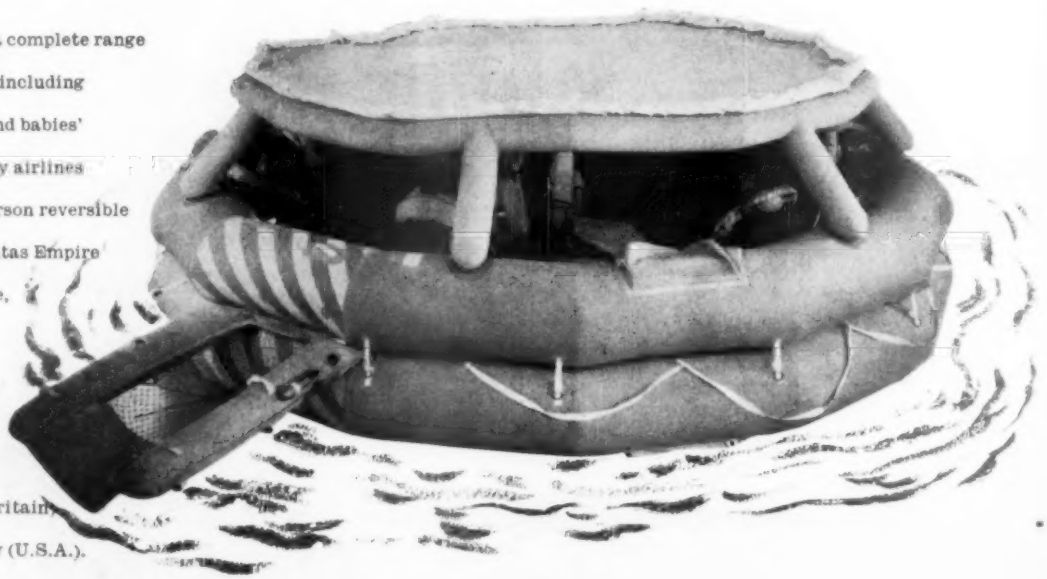

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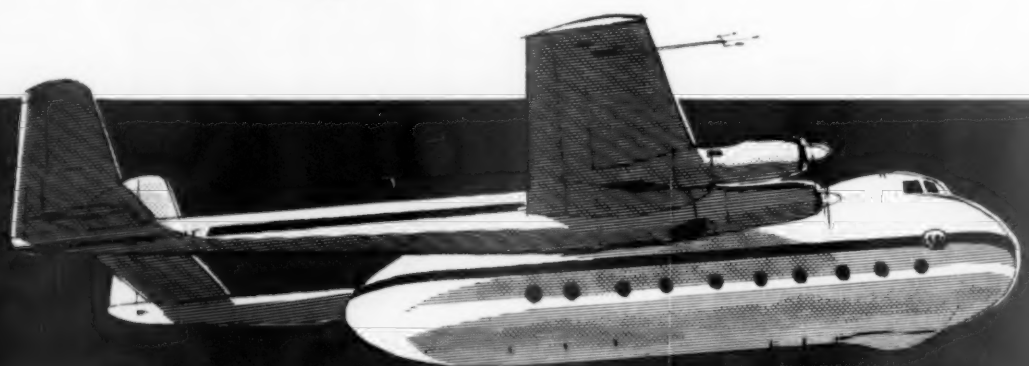

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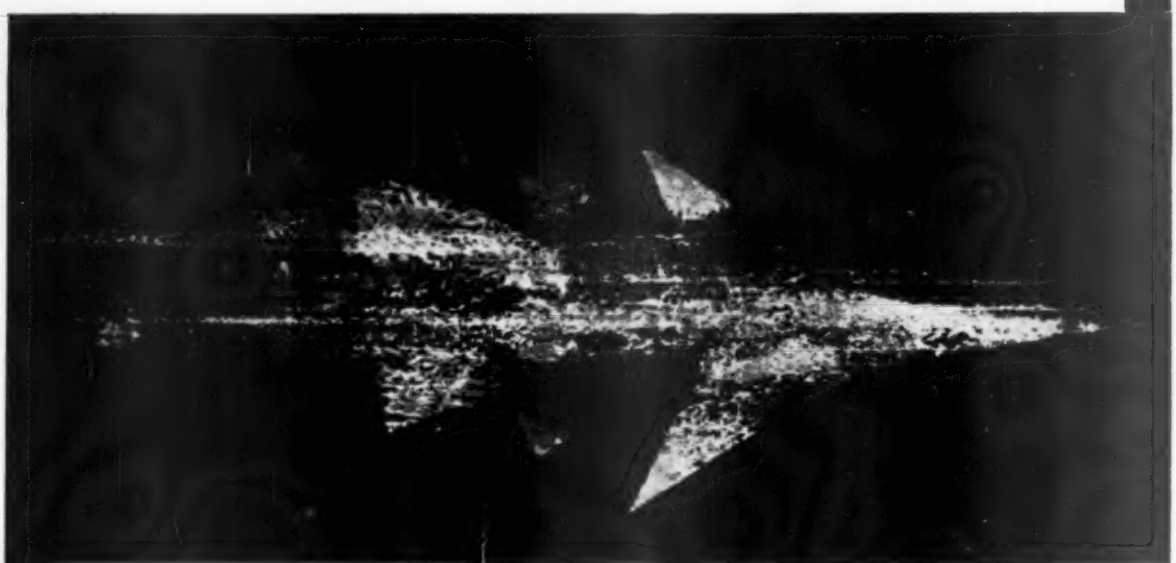

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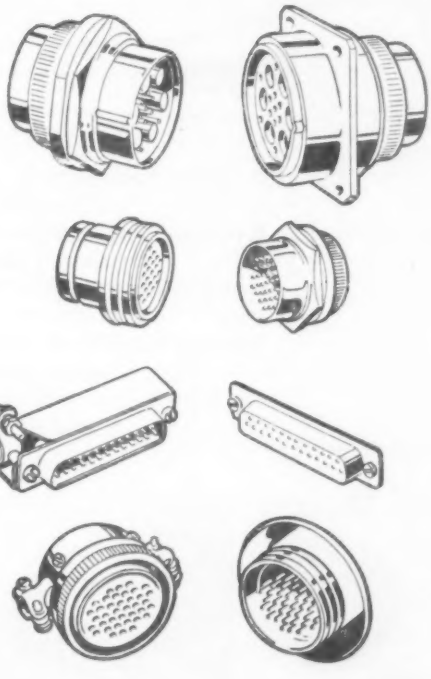

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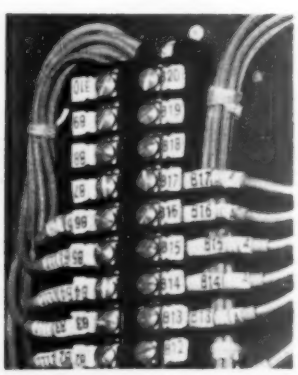

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CLASSIFIED DIRECTORY

This summary of suppliers to the British Aircraft Industry, excluding S.B.A.C. exhibitors, has been condensed from Part III of "The Aeroplane Directory of British Aviation" 1960 Edition. (1) BASIC METALLIC MATERIALS (castings, forgings, sheets, stampings, all metals in unmachined state); (2) NON-METALLIC MATERIALS (adhesives, ceramics, glass fabrics, plastics, rubber, timber); (3) PREFABRICATED COMPONENTS AND PARTS (A.G.S. parts, airframe components, sub-assemblies); (4) TOOLS AND WORKSHOP EQUIPMENT; (5) CONTROLS, SYSTEMS AND ACCESSORIES.

(6) INSTRUMENT EQUIPMENT; (7) RADIO AND ELECTRICAL EQUIPMENT (includes navigational aids and communications); (8) SURVIVAL EQUIPMENT AND FLYING-CLOTHING; (9) MISCELLANEOUS EQUIPMENT AND SERVICES (furnishings, maps, packing, photographic supplies, repair work, research work, seating); (10) AIRPORT CONSTRUCTION AND EQUIPMENT (airfield lighting, fire-fighting, fork-lift trucks, ground power units, passenger steps); (11) FUELS AND OILS; (12) PAINTS, CLEANERS AND FINISHING PROCESSES.

1—Basic Metallic Materials

Aeroplane and Motor Aluminium Castings, Ltd., Wood Lane, Erdington, Birmingham. T.: Erdington 2207-9. Pressure, gravity and sand castings.

Aircraft Engineering and Jigs, Ltd., Wren Works, Chadderton, Lancs. T.: Chadderton 5691. Ferrous and non-ferrous castings.

Albion Drop Forgings Co., Ltd., Foleshill, Coventry. T.: Coventry 88891-3. Forgings, stampings.

Aluminium Corporation, Ltd., 10 Buckingham Place, London, S.W.1. T.: Victoria 9671. Aluminium rollers.

Andrews Toledo, Ltd., Toledo Steelworks, Sheffield, 3. T.: Sheffield 23274. Aircraft steels.

B. Attewell and Sons, Ltd., Reflection Works, Iver, Bucks. R.I.A. guaranteed laminated aluminium shims and packings; Perspex panels and canopies.

Balfour, Arthur, and Co., Ltd., Capital Steel Works, Sheffield, 3. T.: Sheffield 22071. High-speed, alloy tool and plain carbon tool steels.

Birkett, T. M., Billington and Newton, Ltd., Birkett St., Hanley, Stoke-on-Trent. T.: Stoke-on-Trent 22184. Non-ferrous castings and machined parts; Birso chill-cast rods and tubes.

Bolton, Thomas, and Sons, Ltd., Mersey Copper works, Widnes, Lancs. T.: Widnes 2022. Suppliers of copper, brass and bronze.

Bramah, J. R., and Co., Ltd., Devonshire St., Sheffield, 3. T.: Sheffield 24228. Aluminium alloy; Nimonic, etc., fabrications; Argon welding, etc.

Carlisle, C. G., and Co., Ltd., Iona Steel Works, 629 Penistone Rd., Sheffield, 6. T.: Sheffield 348791 and 43796. Stainless-steel bars.

Clifford, Charles, Ltd., Dogpool Mills, Birmingham, 30. T.: Selly Oak 1544. Rolled metal products in tube, rod, non-ferrous bar and wire.

Coley, R. J., and Son (Hounslow), Ltd., Jubilee Works, Chapel Rd., Hounslow, Middx. T.: Hounslow 2266. Metal merchants.

Darwins, Ltd., Fitzwilliam Works, Tinsley, Sheffield, 9. T.: Sheffield 49049. Aircraft steels and machine tools.

Deritend Stamping Co., Ltd., Liverpool St., Deritend, Birmingham, 9. T.: Victoria 2941-5. Forgings and stampings.

Diecastings, Ltd., Highgate Sq., Birmingham, 12. T.: Calthorpe 2241-3. Gravity, die and sand castings.

Doncaster, Daniel, and Sons, Ltd., 284 Penistone Rd., Sheffield, 6. T.: Sheffield 43081. Forgings; turbine blades, etc.

Dudley Drop Forging Co., Ltd., Holly Hall, Dudley, Worcs. T.: Brierley Hill 77561. Forgings in steel, titanium, Nimonic, aluminium, phosphor-bronze.

Equator Wheels and Sections, Ltd., Raglan St., Wolverhampton. T.: Wolverhampton 21605. Stainless-steel stiffening bands. Cold rolling, forming, profiles, etc.

Fry's Metal Foundries, Ltd., Tandem Works, Merton Abbey, London, S.W.19. T.: Mitcham 4023. Solders and fluxes; Fryolux solder paint.

Hadfields, Ltd., East Hecla Works, Tinsley, Sheffield, 9. Alloy and stainless steel; steel castings and forgings; turbine discs.

Jonas and Colver (Novo), Ltd., Novo Steel Works, Sheffield, 9. T.: Sheffield 41245. Aircraft steels.

Kayser, Ellison and Co., Ltd., Carlisle Steel Works, G.P.O. Box 144, Sheffield, 4. T.: Sheffield 22124. High-speed, stainless, heat resisting and alloy steels.

Kiveton Park Steel and Wire Works, Ltd., Kiveton Park, nr. Sheffield. T.: Kiveton 252. Steel bars.

Langley Alloys, Ltd., Langley, Slough, Bucks. T.: Langley 432. Hidurel high-conductivity alloys; Hidurax aluminium bronzes; castings in Langalloy stainless steels and nickel base alloys.

Lavender, J. H., and Co., Ltd., Hall Green Works, Crankhall Lane, West Bromwich. T.: Stone Cross 2273. Aluminium alloy castings.

Lee, Arthur, and Sons, Ltd., Trubrite Steel Works, Meadow Hall, nr. Sheffield. Bars, strip, etc.

Light-Metal Forgings, Ltd., Churchbridge, Oldbury, nr. Birmingham. T.: Broadwell 1152 and 1895. Drop forgings and stampings.

Low Moor Alloy Steel Works, Ltd., The Steel Works, Low Moor, Bradford Yorks. T.: Bradford 77331. Stainless, tool, die and alloy steels.

Manganese Bronze and Brass Co., Ltd., The, 2 London Wall, London, E.C.2. T.: London Wall 8802. Wrought metals and self-lubricating bearings.

Mills, Exors. of James, Ltd., Bredbury St. Works, Woodley, nr. Stockport. Ledloy free-cutting steel, etc.

Mills, William, Ltd., Friar Park Rd., Wednesbury, Staffs. T.: Stonecross 2651-5. Aluminium and magnesium alloy castings, etc.

Mining and Chemical Products, Ltd., 86 Strand, London, W.C.2. T.: Covent Garden 3393. Cerromatrix and Cerrotru fusible alloys; Cerrobend; MCP 15 Alloy.

Morgan, George, Ltd., Grange Rd., Selly Oak, Birmingham, 29. T.: Selly Oak 1156. Drop forgings in alloy, carbon and stainless steels.

Nitralloy, Ltd., Atlas Works, Sheffield, 4. T.: Sheffield 26646. Nitriding process of case-hardening special steels and Nitralloy steels.

Osborn, Samuel, and Co., Ltd., Clyde Steel Works, Sheffield. Aircraft steels.

Perry Barr Metal Co., Ltd., Oscott and Queslett Works, Shady Lane, Gt. Barr, Birmingham, 22a. T.: Gt. Barr 1794. Light alloys.

Rapp, Leo, Ltd. (inc. LR Airsteel, Ltd.), Wimborne Av., Norwood Green, Southall, Middx. T.: Southall 2322. Aluminium and aluminium-alloy sheet, bar, tube, etc.; stainless carbon and alloy steels.

Rapp, Leo (Steel), Ltd., Wimborne Av., Norwood Green, Southall, Middx. T.: Southall 2322. Mild steel, sheets, plates and sections. Steels for jigging and tooling.

Renfrew Foundries, Ltd., Hillington, Glasgow, S.W.2. T.: Halfway 3391. Aiminal castings.

Rollet, H., and Co., Ltd., 6 Chesham Place, London, S.W.1. T.: Belgravia 4300. Non-ferrous materials and stainless steels.

Rotherham Forge and Rolling Mills Co., Ltd., Rotherham, Yorks. T.: Rotherham 3281. Rollers, forgers and drop stampers of steel sheets, bars.

Samlesbury Engineering, Ltd., Samlesbury Airfield, nr. Blackburn, Lancs. T.: Blackburn 44668. Steel extrusions.

Sheepbridge Alloy Castings, Ltd., Hamilton Rd., Sutton-in-Ashfield, Notts. T.: Sutton-in-Ashfield 590. Alloy steel castings.

Sheffield Forge and Rolling Mills, Ltd., Millsands, Sheffield, 3. Aircraft steels.

Smethwick Drop Forgings, Ltd., Rolfe St., Smethwick. T.: Smethwick 1234. Drop forgings.

Smith-Clayton Forge, Ltd., Tower Works, Lincoln. T.: Lincoln 25492. Forgings and drop stampings.

Steel Stampings, Ltd., Cooksley, nr. Kidderminster. T.: Wolverley 266. Pressings in stainless steel and other metals; welded rings.

Titanium Metal and Alloys, Ltd., 2 Metal Exchange Buildings, Leadenhall Avenue, London, E.C.3. T.: Mansion House 4521; and Clyde Steel Works, Sheffield, 2. Titanium rolled bar, forged blanks, rings and sheets.

United Steel Companies, Ltd., The, P.O. Box 64, The Mount, Broomhill, Sheffield, 10. T.: Sheffield 60081; and 8 Grosvenor Gardens, London, S.W.1. Iron and steel plates, sections, forgings; alloy and special steels.

Vaughan Bros. (Drop Forgings), Ltd., Eagle Works, Willenhall, Staffs. T.: Willenhall 436-8. Drop forgings.

Wilson Alloys, Ltd., 114 Nightingale Rd., London, N.22. T.: Bowes Park 8431. Aluminium and aluminium alloys.

Yorkshire Engineering Supplies, Ltd., Upper Wortley Rd., Wortley, Leeds, 12. T.: Leeds 638234 and 638291. Eatonia and E.C.C. castings.

Yorkshire Imperial Metals, Ltd., P.O. Box 166, Stourton, Leeds. T.: Leeds 72222. Solid-drawn tubes, Yorkshire capillary fittings.

Young, A. S. and Co., Ltd., Tower Works, Woodside Lane, London, N.12. T.: Hillside 6606-7. Welding rods and Colmonoy hard-surfacing alloys, Nicrobraz brazing alloy.

2—Non-metallic Materials

British Belting and Asbestos Ltd., Scandinavia Mills, Cleckheaton, Yorks. T.: Cleckheaton 3222. Mintex brake and clutch linings and other friction materials; Asbestos yarns, cloths, tapes, packings and jointings; Scandura P.V.C. fire-proof conveyor belting.

British Moulded Plastics, Ltd., Avenue Works, Walthamstow Av., London, E.4. T.: Larkswood 2323. Telenduron bitumen asbestos compound and mouldings; moulded plastics and extrusions.

B.X. Plastics, Ltd., Higham Station Av., London, E.4. T.: Larkswood 5511. Sheets, rods, tubes, extrusions, foil, etc., in Cobex, Bexoid, Xylonite, B.X. P.V.C., B.X. Polystyrene, and Isoflex (thermal insulation).

Cape Asbestos Co., Ltd., 114 Park St., London, W.1. T.: Grosvenor 6022. Insulating materials, linings; building and insulation boards.

Cork Manufacturing Co., Ltd., Hall Lane, South Chingford, London, E.4. T.: Silverthorn 1101. Langite and Neolangite jointings and packings.

Daleman, Richard, Ltd., 325-327 Latimer Rd., London, W.10. T.: Ladbroke 3709. Evolite Perspex (acrylic) tubes and cylinders.

Expanded Rubber Co., Ltd., Mitcham Rd., Croydon, Surrey. Onazote expanded acylonitrile for radomes; Rubazote soft expanded rubber.

Ferodo, Ltd., Chapel-en-le-Frith, Stockport. T.: Chapel-en-le-Frith 2520. Friction materials.

Gosheron John, and Co., Ltd., Packaging and Industrial Tape Centre, Albert Embankment, London, S.E.11. T.: Reliance 7600-9. Self-adhesive tapes.

Jones, Samuel and Co., Ltd., New Bridge St., London E.C.4. T.: Central 6500. Self-adhesive tapes.

Kautex, Ltd., Elstree Way, Elstree, Herts. T.: Elstree 1777-9. Neo-K-Tex jointings; anti-vibration and insulation packings.

Leicester, Lovell and Co., Ltd., North Baddesley, Southampton, Hants. T.: Rownhams 363. Casco synthetic resins and Casein glues.

Mandleberg, J., and Co., Ltd., Albion Works, Cobden St., Pendleton, Salford 6, Lancs. T.: Pendleton 1441. Proofed fabrics for balloons, dinghies, flotation gear, inflatable chairs, aircraft covers, etc.

Minnesota Mining and Manufacturing Co., Ltd., 3M House, Wigmore St., London, W.1. Scotch Boy cellulose and masking tapes, 3M adhesive coatings and sealers; 3M coated abrasives.

Morgan Crucible Co., Ltd., The, Battersea Church Rd., Battersea, London, S.W.11. T.: Battersea 8822. Morganite carbon and metal-graphite brushes and contacts. Carbon piles and electrodes.

Moulded Components (Jablo), Ltd., Mill Lane, Croydon, Surrey. T.: Croydon 2201. Airscrew and helicopter blades, etc. Sandwich panels with Aero Jablex core; glass-fabric facings; thermal and sound insulation.

Nobrac Carbon, Ltd., Commerce Way, Lancing, Sussex. T.: Lancing 2053. Specialist grade carbons.

North British Plastics, Ltd., Patterson St., Blaydon-on-Tyne. T.: Blaydon 346-9. Panax paper-base laminated sheets, etc.

Peradia Rubber, Ltd., Freshford, nr. Bath, Somerset. T.: Limpley Stoke 3263. Peratol sealing compound.

Plastikade (Manchester), Ltd., Central Mill, Woodstock St., Oldham, Lancs. T.: Oldham (Main) 9261-3. Polyurethane foams for thermal and [illegible] insulation.

R[illegible]olas, Ltd., 66 Victoria St., L[illegible] S.W.1. T.: Victoria 6501. Ru[illegible] sheeting, etc.

Trade Directory . . . .

Scott, Bader and Co., Ltd., Wollaston, Wellingborough, Northants. T.: Wollaston 262. Marco and Crystic polyester resins.

Smith and Nephew, Ltd., Bessemer Rd., Welwyn Garden City, Herts. T.: Welwyn Garden City 5151. Lasso self-adhesive tapes.

Sorbo, Ltd., Woking, Surrey. T.: Woking 966. Rubber goods.

Surridge's Patents, Ltd., New Works, Croydon Rd., Elmers End, Beckenham, Kent. T.: Beckenham 0168. Holdtite adhesives.

Tinkertex, Ltd., Bottoms Mill, Holmfirth, nr. Huddersfield. T.: Holmfirth 636. Aircraft upholstery cloth and curtaining. Uniform cloths.

Wallington, Weston and Co., Ltd. (Inc. Frome Plastics, Ltd.), Vallis Mills, Frome, Somerset. T.: Frome 2206. Hibudine seals and gaskets. Fromoplas plastics sheets, mouldings and moulding powder. Flexlite sponge rubber.

Warerite, Ltd. (unit of Bakelite, Ltd.), Watton Rd., Ware, Herts. Decorative laminated plastics.

Wright, John and Sons (Veneers), Ltd., Avon Wharf, Longfellow Rd., Mile End Rd., London, E.3. T.: Advance 4444. British-cut veneers for construction and decoration.

3—Prefabricated Components and Parts

Abbey Panel and Sheet Metal Co., Ltd., Bayton Rd., Exhall, nr. Coventry. T.: Bedworth 2071. Aircraft fabrications, cowls and assemblies.

Aerocontacts, Ltd., Gatwick Airport, Horley, Surrey. T.: Horley 4455. A.G.S. parts, accessories and components.

Aerolex, Ltd., Bridge Rd., Camberley, Surrey. T.: Camberley 1500. Components and assemblies.

Aeroparts Engineering Co., Ltd., Commercial Rd., Hereford. T.: Hereford 3068. Assemblies and components; lubrication equipment.

Aircraft Engineering and Jigs, Ltd., Wren Works, Chadderton, Lancs. T.: Chadderton 5691. Components.

Aircraft-Marine Products (Gt. Britain), Ltd., Amplo House, 87-89 Saffron Hill, London, E.C.1. T.: Chancery 2902-8. Solderless terminals and connectors.

Amal, Ltd., Holdford Rd., Witton, Birmingham, 6. T.: Birchfields 4571. Flame traps, fuel filters, precision components and assemblies.

Angus, George, and Co., Ltd., Angus House, Newcastle upon Tyne, 1. T.: Newcastle upon Tyne 22656-9. Gaco oil seals, hydraulic packings and mouldings, brake and clutch linings, gears, fire extinguishers, fire hose, transmission and conveyor belting.

Arens Controls, Ltd., Trowers Way, Holmethorpe, Redhill, Surrey. T.: Redhill 5511-3. Remote controlling gear; operating boxes; end fittings.

Armstrong Patents Co., Ltd., Eastgate, Beverley, Yorks. Heli-coil screw thread inserts and high-endurance nuts.

Aston, E. S., and Co., Ltd., 5 Sebastian St., Goswell Rd., London, E.C.1. T.: Clerkenwell 2179. Instrument panel cleats; fairleads; packings and control knobs in laminated plastics and cast resins.

B. Attewell and Sons, Ltd., Reflection Works, Iver, Bucks. R.L.A. guaranteed laminated aluminium shims and packings; Perspex panels and canopies.

Autoset (Production), Ltd., Stour St., Birmingham, 18. T.: Edgbaston 1143-4. Springs and rubber-suspension equalizing castors; fixed-direction wheel brackets; castors.

Avery Equipment, Ltd., Tachbrook Rd., Leamington Spa. T.: Leamington Spa 2700. Flexible hose and self-sealing couplings.

Aviation Traders (Engineering), Ltd., 21 Wigmore St., London, W.1. T.: Museum 7791; Southend Airport, Essex. T.: Rochford 56491; and Stansted Airport, Essex. T.: Takeley 391. A.G.S. parts major and sub-airframe assemblies; gas-turbine sheet-metalwork; tubular fabrications.

Barber and Colman, Ltd., Marsland Rd., Brooklands, Manchester. T.: Sale 2277. Shakeproof thread-cutting screws; lock washers.

Baxter's (Bolts, Screws and Rivets), Ltd., Parade Works, Sheepcote St., Birmingham, 15. T.: Midland 0105. Bolts and rivets.

Beckett, Laycock and Watkinson, Ltd., Acton Lane, Harlesden, London, N.W.10. T.: Elgar 5403. Glazed assemblies. Beclawat silent window channel.

B.M.B. (Sales), Ltd., High St., Crawley, Sussex. Steel bearings and balls. Miniature bearings.

Borg and Beck Co., Ltd., Tachbrook Rd., Leamington Spa. T.: Leamington Spa 2700. Clutches.

Brumah, J. R., and Co., Ltd., Devonshire St., Sheffield, 3. T.: Sheffield 24228. Aircraft tanks. Aluminium alloy, Nimonic, titanium, stainless steel fabrications.

Brauer, F., Ltd., Grove Road, Harpenden, Herts. T.: Harpenden 3603. Toggle clamps.

British Timken (Division of the Timken Roller Bearing Co.), Duston, Northampton. Tapered roller bearings.

British Tyre and Rubber Co., Ltd., Herga House, Vincent Sq., London, S.W.1. T.: Victoria 3848. Rubber de-icing, seals, etc.

British Wire Products, Ltd., Worcester Rd., Stourport-on-Severn, Worcs. T.: Stourport 240. Controls and cables; Britloc wire rope slings, oil filters, pipe-bending, etc.

Brown, E. G., and Co., Ltd., West Rd., Northumberland Park, Tottenham, London, N.17. T.: Tottenham 2257. Fuel and oil tanks, pilots' seats, tailplane assemblies and elevators, cowlings, pressings, stampings.

Burnley Aircraft Products, Ltd., Fulledge Works, Holmes St., Burnley. T.: Burnley 7681. Wing flaps, bomb doors and hatches, jettison tanks. Steel components.

Carr Fastener Co., Ltd., Stapleford, Nottingham. T.: Sandiacre 3085. Fasteners.

Cathodeon, Ltd., Church St., Cambridge. T.: Cambridge 56481. Hermetic glass-to-metal seals. Vacuum tubes and high-voltage vacuum relays.

Clayton-Wright, Howard, Ltd., Wellesbourne, Warwickshire. T.: Wellesbourne 316-7-8. Clitonrite self-sealing weatherstrip; Nylastic adjustable cable and Clatonrite anti-vibro cable support clips; Harrisflex anti-vibration mountings; Clayflex flexible-bearings; Nylastic bearings; Clatonrite Stikastrip.

Corner, G., and Co., Ltd., Johnson Brook Rd., Hyde, Cheshire. T.: Hyde 3493. Sheet metal assemblies.

Coventry Climax Engines, Ltd., Widdrington Rd. Works, Coventry. T.: Coventry 62607. Accessories.

Cramic Aircraft Components, Ltd., Bridge Road, Southall, Middx. T.: Southall 3411. Components in aluminium alloys and non-ferrous metals.

Crane Packing, Ltd., Slough, Bucks. T.: Slough 24031. Band packings and mechanical seals. Processors and fabricators of P.T.F.E.

Cross Manufacturing Co. (1938), Ltd., 33 Midford Rd., Combe Down, Bath. T.: Combe Down 2355. Spring washers, labyrinth seals, wire-thread inserts, springs, etc.

Curd Components, Ltd., 41 Lonsdale Rd., London, W.11. T.: Bayswater 0319 and 6866. Standard aircraft parts.

Davis and Timmins (Aircraft), Ltd., Billet Rd., Walthamstow, London, E.17. T.: Ilford 3460. A.G.S., B.S.S. and A.S. parts.

Equator Wheels and Sections, Ltd., Raglan St., Wolverhampton. T.: Wolverhampton 21605-6. Stainless steel stiffening bands for jet engines; cold rolling, forming and coiling in all metals; profile manipulations.

Fafnir Bearing Co., Ltd., Upper Villiers St., Wolverhampton. T.: Wolverhampton 26101. Ball and parallel roller bearings and transmission equipment.

Fletcher, C. W., and Sons, Ltd., Sterling Works, Arundel St., Sheffield, 1. T.: Sheffield 28049 and 28040. Precision sheet-metal work.

Flexello Castors and Wheels, Ltd., Trading Estate, Slough, Bucks. T.: Slough 24121. Wheels, castors and bearings.

Flexible Ducting, Ltd., Shuna Street, Maryhill, Glasgow. "Flexflyte" lightweight flexible hose.

Flexibox, Ltd., Nash Rd., Trafford Park, Manchester, 17. T.: Trafford Park 1477. Mechanical seals. Precision lapping machines.

Fox, C. J., and Sons, Ltd., 117 Victoria St., London, S.W.1. T.: Victoria 0204-5, 5735-6. Kaylock self-locking nuts and fasteners

Hardy Spicer, Ltd., Chester Rd., Erdington, Birmingham, 24. T.: Erdington 2191. Universal joints and cardan shafts.

Harper, C. E., Aircraft Co., Ltd., Exeter Airport, Clyst Honiton, Devon. T.: Exeter 67451. Components and sub-assemblies.

Henderson Safety Tank Co., Ltd., The, Elstree Way, Borcham Wood, Herts. T.: Elstree 1758-9 and 1917. Tanks; sections and turned parts.

Heston Aircraft and Associated Engineers, Ltd., Heston Airport, Hounslow, Middx. T.: Hayes 38441. Sub-assemblies and components.

Hobourn Aero Components, Ltd., Strood, Rochester, Kent. T.: Strood 7626. Machined components.

Hoffmann Manufacturing Co., Ltd., The, New St., Chelmsford, Essex. T.: Chelmsford 3151. Ball and roller bearings.

Inferation, Ltd., Yorktown Industrial Estate, Camberley, Surrey. Galley equipment and floor warming mats.

Jack, E. J., Ltd., 154 Camden High St., London, N.W.1. T.: Gulliver 5761. Fafnir and other American ball and roller bearings.

Lawrence, J. W., Ltd., Abbey Lane, Leicester. T.: Leicester 62441. Radiators, oil coolers and heat exchangers.

Lentern Aircraft, Ltd., Main Road, Hawkwell, Hockley, Essex. Repetition parts.

Linread, Ltd., P.O. Box 21, Cox St., Birmingham, 3. T.: Central 3951. Fasteners, bolts, screws and rivets. Special cold-forged products.

Metalastik, Ltd., Evington Valley Rd., Leicester. T.: Leicester 37281. Rubber-to-metal weld anti-vibration devices; engine-mounting systems; mountings; couplings, undercarriage suspension, etc.

Middleton Sheet Metal Co., Ltd., Spring Vale Works, Middleton, Manchester. T.: Middleton 2427-8. Resistance welding, aircraft control surfaces, access doors, etc. Jet-engine canware; tanks and containers; glass-fibre plastic moulding.

Midland Aeroequipment, Ltd., Park Rd., Bloxwich, nr. Walsall, Staffs. T.: Bloxwich 66414. Aircraft locks and fastenings.

Moore's (Bournemouth), Ltd., Wallisdown Rd., Bournemouth. T.: Winton 5810. High-precision machining prototype and assembly work; aircraft fabrications.

Mountford, Fredk. (Birmingham), Ltd., Fremo Works, Moseley St., Birmingham. T.: Midland 7984. A.G.S. parts; pins, bolts, screws and nuts in stainless steel.

Newton, L. H., and Co., Ltd., Nechells, Birmingham, 7. T.: East 1551. Special precision components. Bolts, nuts, screws, rivets and washers. Capstan and automatic work. Light pressings; cold forged special work in all metals.

Nobrac Carbon, Ltd., Commerce Way, Lancing, Sussex. T.: Lancing 2053. Carbon brush seals; high-altitude brushes.

Northey Rotary Compressors, Ltd., Alder Rd., Parkstone, Dorset. T.: Parkstone 4900-1. Exhausters for high-altitude instrument testing. Oil-free compressors. Gas boosters for experimental process plant.

Oddie Fasteners, Ltd., Portswood Rd., Southampton. T.: Southampton 55883. Oddie fasteners, quick-release pins.

Opperman, S. E., Ltd., Stuart Works, Stirling Corner, Borcham Wood, Herts. T.: Elstree 2021. Aircraft components, gears and gearing, motor units and materials.

Parkes, L. B., and Co., 16 Station St., Walsall. T.: Walsall 4546. Anodizing and metal finishing; pressings and stampings. Crash- and fire-proofing petrol and oil tanks.

Peradin Rubber, Ltd., Freshford, nr. Bath, Somerset. T.: Limpley Stoke 3263. Precision moulded parts and bonded rubber-to-metal parts.

Power Flexible Tubing Co., Ltd., The, Derby Works, Vale Rd., London, N.4. T.: Stamford Hill 6696. Flexible metal bellows, tubing, etc.

Randall, James H., and Son, Ltd., Paddington Green Works, London, W.2. T.: Ambassador 1661. Sheet metal work. Spinning.

Ransome and Marles Bearing Co., Ltd., Stanley Works, Newark-on-Trent. T.: Newark 456. Bearings.

Renold Chains, Ltd., Renold House, Wythenshawe, Manchester. T.: Mercury 5221. Precision chains.

Riley, Robert, Ltd., Milkstone Spring Works, Rochdale. T.: Rochdale 2237. Aircraft springs. Specialists in beryllium copper springs.

Robinson, L., and Co. (Gillingham), Ltd., 26 London Chambers, Gillingham, Kent. T.: Gillingham 51182. Jubilee clips.

Rose Bros. (Gainsborough), Ltd., Albion Works, Gainsborough, Lincs. Spherical gearing rod ends.

Salisbury Precision Engineering, Ltd., Heston Airport, Hounslow, Middx. T.: Hayes 3844. Airframe sections, ground equipment, optical inspection projectors.

Salter, Geo., and Co., Ltd., High St., West Bromwich. T.: West Bromwich 1855. Springs, roller bearings, circlips, retaining rings, fasteners, Grey-iron castings.

Samlesbury Engineering, Ltd., Samlesbury Airfield, nr. Blackburn, Lancs. T.: Blackburn 44668. Major aircraft components; jigs, tools and fixtures; precision machinists.

Sheepbridge Alloy Castings, Ltd., Hamilton Rd., Sutton-in-Ashfield, Notts. T.: Sutton-in-Ashfield 590. Bi-metal brake drums.

Siegrist Orei, Ltd., 39 Berners St., London, W.1. T.: Museum 0032. Neoprene and Latex sleeves and cable markers. Electrical instruments.

Simplifix Couplings, Ltd., Beacon Works, Hargrave Rd., Maidenhead, Berks. T.: Maidenhead 5100. Joints for copper, steel and light alloy tubes.

Skefko Ball Bearing Co., Ltd., The, Luton, Beds. T.: Luton 5700. Ball bearings, cylindrical, taper and spherical roller bearings; pulleys and rollers.

Stewart Aeronautical Supply Co., Ltd., Adastral House, Lowfield Heath, Crawley, Sussex. T.: Horley 4300. Aeronautical equipment, spares.

Stream-Line Filters, Ltd., Ingate Pl., London, S.W.8. T.: Macaulay 1011-3. Filters for aviation fuels; water separators.

Superflexit, Ltd., 118 Buckingham Av., Slough, Bucks. T.: Slough 24561. Non-metallic flexible tubing.

Taylor, C. F., (Metal Workers), Ltd., Molly Millars Lane, Wokingham, Berks. T.: Wokingham 1005-6. Aircraft fuel tanks, pressure ducting, galley equipment, toilets, steps.

Tempered Spring Co., Ltd., The, Warren St., Sheffield, 4, Yorks. T.: Sheffield 21333. Springs.

Tenaplas, Ltd., Upper Basildon, nr. Pangbourne, Berks. T.: Upper Basildon 333-6. Extrusions and fabrications in polythylene, p.v.c., nylon; drape and vacuum forming epoxy resins.

Terry, Herbert, and Sons, Ltd., Redditch, Worcs. T.: Redditch 61. Springs, presswork, wirework, hose clips, Anglepoise lamps, etc.

Torrington Co., Ltd., The, Torrington Av., Coventry. T.: Coventry 74241-6. Needle and roller bearings; bolts and screws.

Tucker Eyelet Co., Geo., Ltd., Walsall Rd., Birmingham, 22B. T.: Birchfields 4811. "Pop" and "Imex" rivets; eyelets and small metal pressings.

Turner and Savage, Ltd., 140 Willesden Lane, London, N.W.6. T.: Maida Vale 4881. Panel beaters and sheet-metal specialists.

(*Continued on page 333*)

TO DATE 375 SUCCESSFUL ESCAPES

have been made using

MARTIN-BAKER EJECTION SEATS

The result of 16 years experience and more than 850 test ejections.

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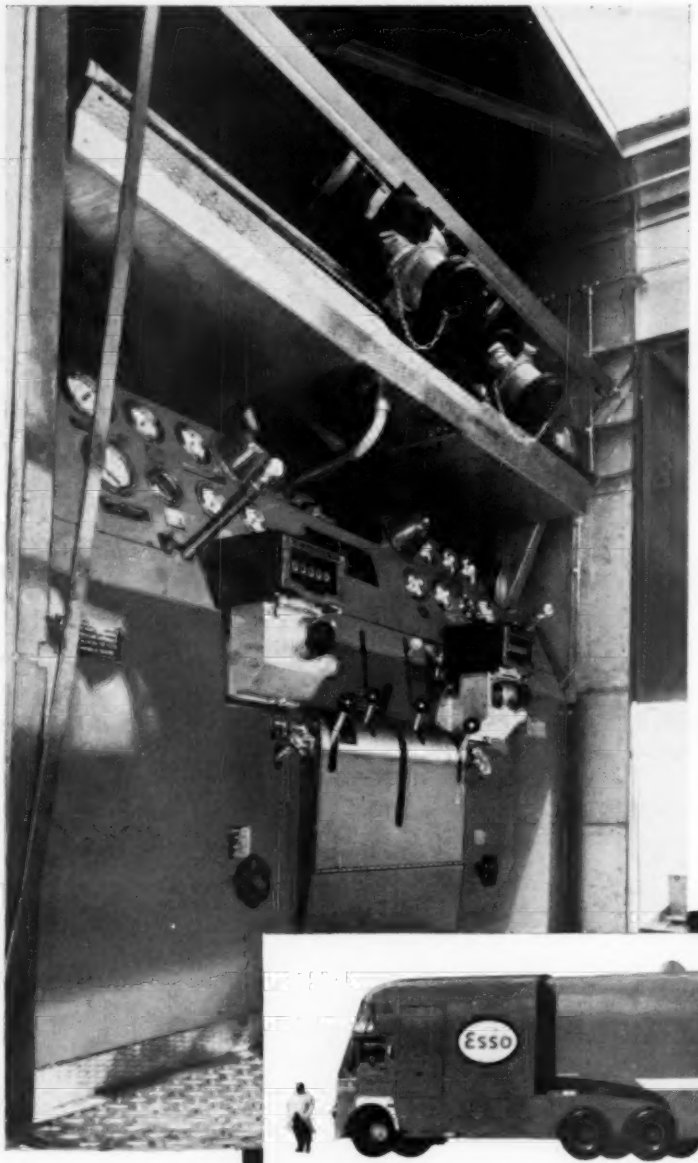
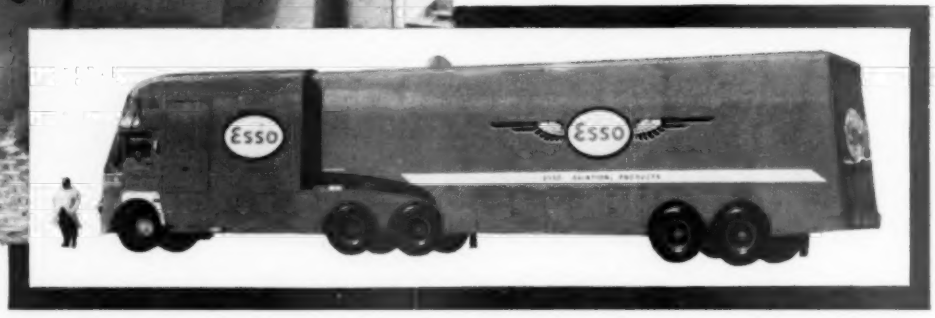


Faster Fuelling for Modern Airliners



Large modern airliners such as the Boeing 707 and the DC-8 have fuel capacities approaching 20,000 Imperial gallons. In order to maintain a quick turn-round at airports with such aircraft, a new range of superfuellers with capacities of 10,000 gallons or more has been developed. Avery-Hardoll equipment chosen for these superfuellers includes Bulkmeters, Slow-Close Valves, Automatic Bottom Loading Equipment and Self-Sealing Couplings.

The "Python" 12,000 gallon fueller illustrated here is built by the Steel Barrel Co. Ltd. for the Esso Petroleum Co. Ltd. and employs Avery-Hardoll Bulkmeters of 650 I.G.P.M. capacity. The Hose Units, Couplings and Automatic Bottom Loading Equipment (for loading at 1000 I.G.P.M.) are also by Avery-Hardoll.

Avery-Hardoll equipment has also been chosen for the "Severn" fueller, built by Zwicky Ltd. for Shell-Mex and B.P. Ltd. and for the "Yorkshire" fueller built by Saunders Roe (Anglesey) Ltd. for British Petroleum Ltd. Both these units have a capacity of 10,000 Imperial gallons.

Avery-Hardoll

AVERY-HARDOLL LTD., OAKCROFT ROAD, CHESSINGTON, SURREY, ENGLAND
Telephone: ELMbridge 5221

Trade Directory . . . .

(Continued from page 332)

United Steel Companies, Ltd., 17 Westbourne Rd., Sheffield, 10. T.: Sheffield 60081; and 8 Grosvenor Gardens, London, S.W.1. T.: Sloane 4533. Steel strip and wire.

Vandervell Products, Ltd., Western Av., London, W.3. T.: Acorn 2251. Thin-wall precision-finished crankshaft main and connecting-rod big-end bearings; thin-wall bushings and thrust washers.

Weathershields, Ltd., 147-169 Bishop St., Birmingham, 5. T.: Midland 5876. Seats, upholstery, hoodings; sheet metal fabrications.

Weston, Charles, and Co., Ltd., Irwell Bank Works, Douglas Green, Pendleton, Salford, 6. T.: Pendleton 2857-9. Oil seals and oil-sealing.

Weyburn Engineering Co., Ltd., Elstead, Godalming, Surrey. T.: Elstead 2141. Precision engineers. Camshafts, governors, pumps, etc.

Wilkinson Rubber Linatex, Ltd., Frimley Rd., Camberley, Surrey. T.: Camberley 1595. Flexatex hose; self-sealing tank coverings; Linatex seals.

Y.S.C., Ltd., The, 45-47 Copeland Rd., London, S.E.15. T.: New Cross 6113. A.G.S. spares; bolts, screws.

4——Tools and Workshop Equipment

Abingdon King Dick, Ltd., Tyseley Birmingham, 11. Hand tools for repair and maintenance.

Adcola Products, Ltd., Gauden Rd., London, S.W.4. T.: Macaulay 4272. Soldering instruments and equipment; solder jointing for radio and radar.

AEI-Birlec, Ltd., Tyburn Rd., Erdington, Birmingham, 24. T.: East 1544. Electric and gas furnaces; absorption dryers; compressed-air systems; gas generators.

Aerocontacts (Ground Equipment), Ltd., Gatwick Airport, Horley, Surrey T.: Horley 4455. Aircraft ground equipment and workshop equipment.

Aerograph Co., Ltd., 47 Holborn Viaduct, London, E.C.1. T.: City 4361. Spray-painting equipment.

Aerolex, Ltd., Camberley, Surrey. T.: Camberley 1500. Assemblies and tools.

Aircraft Engineering and Jigs, Ltd., Wren Works, Chadderton, Lancs. T.: Chadderton 5691. Jigs and tools.

Air Industrial Developments, Ltd., Aidspray Works, Shenstone, nr. Lichfield, Staffs. T.: Shenstone 341-5. Spray-painting and compressed-air equipment.

Allied Electronics, Ltd., 28 Upper Richmond Rd., Putney, London, S.W.15. T.: Vandyke 1856. Simmonds Pacitor fuel-gauge test console.

Amal, Ltd., Holdford Rd., Witton, Birmingham, 6. T.: Birchfields 4571. Jet-calibrating machines; Bunsen burners and injectors.

Archdale, James, and Co., Ltd., Blackpool Works, Worcester. Milling and drilling machines, etc.

Asquith, Wm., Ltd., Halifax House, Strand, London, W.C.2. T.: Trafalgar 7224. Drilling and horizontal-boring machines.

Atkin, W. T. (Tottenham), Ltd., 178 St. Ann's Rd., Tottenham, London, N.15. T.: Stamford Hill 6686. Press toolmakers and metal stampers.

Autoset (Production), Ltd., Stour St., Birmingham, 18. T.: Edgbaston 1143-4. Castors, drawer slides, engineers' clamps, bearings, trucks, trolleys and transporters.

Aviation Traders Ltd., 21 Wigmore St., London, W.1. T.: Museum 7791; Southend Airport, Essex. T.: Rochford 56491; and Stansted Airport, Essex. T.: Takeley 391. Engine stands and test-bed installations, jigs and fixtures.

Balfour, Arthur, and Co., Ltd., Capital Steel Works, Sheffield, 3. T.: Sheffield 22071. Small tools.

Bardolph, J. F., and Partners, Ltd., 1 Robert St., Adelphi, London, W.C.2. T.: Trafalgar 1927. Myers riveting clamps.

Benton and Stone, Ltd., Enots Works, Aston Brook St., Birmingham, 6. T.: Aston Cross 1905. Centralized lubricating systems; machine-tool coolant fittings, etc.

Berk, F. W., and Co., Ltd. (Coating Division), Brent Cres., North Circular Rd., N.W.10. T.: Elgar 3533. Shot-blasting; metal and plastic spraying and supply of associated equipment.

Black and Decker, Ltd., Harmondsworth, Middx. T.: Skyport 2411-9. Portable electric tools; screwdrivers; sanders, polishers and drills.

Britool, Ltd., Britool Works, Bushbury, Wolverhampton. T.: Wolverhampton 31281. Ratchet and fixed-socket spanners, ring, open-jaw and torque wrenches.

Brooke Tool Manufacturing Co., Ltd., The, Warwick Rd., Greet, Birmingham, 11. T.: Victoria 2323. Engineers' small tools, jigs and fixtures.

Broom and Wade, Ltd., High Wycombe, Bucks. T.: High Wycombe 1630. Air compressors and pneumatic tools.

B.S.A. Tools, Ltd. (Sole Agents, Burton, Griffiths and Co., Ltd.), Kitts Green, Birmingham, 13. T.: Stechford 3071 (machine tools); Victoria 2351 (small tools). Tools.

Burnley Aircraft Products, Ltd., Fulledge Works, Burnley, Lancs. T.: Burnley 7681. Jigs and tools.

Burton, Griffiths and Co., Ltd., Machine Tool Division, Kitts Green, Birmingham, 33. T.: Stechford 3071; and Small Tools Division, Montgomery St., Birmingham, 11. T.: Victoria 2351. Machine and small tools.

Carter, B. and F., and Co., Ltd., Albion Works, Bolton. T.: Bolton 4344. Counting instruments.

Chamberlain Industries, Ltd., Staffa Works, Argall Av., Leyton, London, E.10. T.: Leytonstone 3678. Tube-bending machines, presses, hydraulic rams and pumps.

Churchill, Charles, and Co., Ltd., Coventry Rd., South Yardley, Birmingham. T.: Acocks Green 2281. Machine tools.

Churchill Machine Tool Co., Ltd., The, Broadheath, Manchester. T.: Altrincham 3262. Machine tools.

Constructors, Ltd., Tyburn Rd., Birmingham, 24. Steel storage equipment.

Cornercroft, Ltd., Ace Works, Queen Victoria Rd., Coventry. T.: Coventry 23391. Jigs, press tools, special-process machines, gauges.

Darwins, Ltd., Tinsley, Sheffield, 9. T.: Sheffield 41341. Hacksaw blades; permanent magnets, tool bits.

Dowding and Doll, Ltd., 364 Kensington High St., London, W.14. T.: Western 8077. Machine tools, injection-moulding and die-casting machines; thread-milling hobs.

Dunlop and Ranken, Ltd., 147 The Headrow, Leeds, 1. T.: Leeds 27301. Engineers' and contractors' hand-forged tools.

Edwards, F. J., Ltd., 359-361 Euston Rd., London, N.W.1. T.: Euston 4681. Machine tools and presses.

Equipment and Engineering Co., Ltd., The, 2-3 Norfolk St., Strand, London, W.C.2. T.: Temple Bar 1088. Electro-magnetic crack detectors; Magnaflux crack-detecting ink.

Ferro Enamels, Ltd., Wombourne, Wolverhampton. T.: Wombourne 2281. Furnaces for high-temparature ceramic coatings on nickel-chrome alloys and sheet iron.

Fielding and Platt, Ltd., Atlas Works, Gloucester. T.: Gloucester 20351. Hydraulic drawing, extrusion and forging presses; stretch-forming machines.

Firth Brown Tools, Ltd., Speedicut Works, Carlisle St. E., Sheffield, 4. T.: Sheffield 27151. Engineers' cutting tools.

Henderson Safety Tank Co., Ltd., The, Elstree Way, Boreham Wood, Herts. T.: Elstree 1758-9 and 1917. Jigs and tools.

Herbert, Alfred, Ltd., P.O. Box No. 30, Edgwick Works, Coventry. T.: Coventry 88781. Machine tools; small tools; grinding wheels; measuring and inspection equipment.

Holbrook Machine Tool Co., Ltd., 44 Martin St., Stratford, London, E.15. T.: Maryland 2451. Precision lathes.

Hopkins, E. C., Ingleby Works, Grosvenor St. West, Birmingham, 16. Flexible shaft machines.

King, Geo. W., Ltd., Argyle Works, Stevenage, Herts. T.: Stevenage 440. Gantry cranes, conveyors, hoisting equipment and sliding-door gear, etc.

Lacy-Hulbert and Co., Ltd., Boreas Works, Beddington, Croydon. T.: Croydon 5504. Compressors, vacuum pumps, exhausters, desiccators, spray-painting equipment and pneumatic appliances.

Leytonstone Jig and Tool Co., Ltd., Leytool Works, High Rd., Leyton, London, E.10. T.: Leytonstone 5022. Jigs, fixtures and press tools and equipment.

Light Soldering Developments, Ltd., 28 Sydenham Road, Croydon, Surrey. Soldering equipment.

Loewy Engineering Co., Ltd., The, Wallisdown Rd., Bournemouth, Hants. T.: Winton 5000; and 1 Albemarle St., London, W.1. T.: Hyde Park 9959. Martin Marform metal-forming equipment.

Marbaix, Gaston E., Ltd., Devonshire House, Vicarage Cres., Battersea, London, S.W.11. T.: Battersea 8888. Machine tools.

Marley, W. H., and Co., Ltd., New Southgate Works, 105 High Rd., London, N.11. T.: Enterprise 5234 and 5578. Machine-tool accessories.

Martonair, Ltd., Parkshot, Richmond, Surrey. Pneumatic equipment; air hoists.

Masson Seeley and Co., Ltd., 137-139 Euston Rd., London, N.W.1. T.: Euston 9021-7. Masseeley nameplate machines; stamping and marking machines and presses. Aircraft and engine components.

Mercury Truck and Tractor Co., Ltd., The Quay, Gloucester. T.: Gloucester 24451-2. Hydraulic test equipment and tripod jacks; power-plant stands.

Morgan Crucible Co., Ltd., The, Battersea Church Rd., Battersea, London, S.W.11. T.: Battersea 8822. Crucibles and crucible furnaces. Morganite carbon brushes.

Morris, B. O., Ltd., Morrisflex Works, Briton Rd., Stoke, Coventry. T.: Coventry 53333. Morrisflex flexible shaft equipment, polishing lathes, backstand idlers and polishing materials; rotary files, cutters and rasps; special-purpose machines.

Neill, James, and Co. (Sheffield), Ltd., Napier St., Sheffield, 11. T.: Sheffield 26781. Steel Eclipse hacksaw blades and frames; engineers' tools, permanent magnets and chucks.

Nettlefold and Moser, Ltd., 170-194 Borough High St., London, S.E.1. T.: Hop 7111. Electric and hand tools; transmission equipment.

Northey Rotary Compressors, Ltd., 200-202 Alder Rd., Parkstone, Poole, Dorset. T.: Parkstone 4900. Blowers for electro-plating, metal polishing and spray-painting plants.

Power Flexible Tubing Co., Ltd., The, Derby Works, Finsbury Park, London, N.4. T.: Stamford Hill 6696. Flexible metallic tubing and couplings; flexible shaft outer casings; cable armouring; bellows-type expansion joints.

Power Jacks, Ltd., Valetta Rd., Acton, London, W.3. T.: Shepherds Bush 3443. Hydraulic jacks and Newton Hydratruck hydraulic lift trucks.

Randall, James H., and Son, Ltd., Paddington Green Works, London, W.2. T.: Ambassador 1661. Workshop equipment.

Randalrak, Ltd., 106 Victoria St., London, S.W.1. T.: Victoria 3485. Randalrak industrial storage and handling equipment; Planstore storage and filing equipment.

Robertson, W. H. A., and Co., Ltd., Lynton Works, Bedford. T.: Bedford 66271. Trimming and slitting equipment, etc.

Rossell, Henry, and Co., Ltd., Waverley Works, Effingham Rd., Sheffield. Jigs, fixtures and engineers' small tools.

Salter, Geo., and Co., Ltd., West Bromwich. T.: West Bromwich 1855. Weighing machines and spring balances.

Schrader's Son, A., Division of Scovill Manufacturing Co., 829 Tyburn Rd., Erdington, Birmingham, 24. Tyre valves, parts and pressure gauges.

Scintilla, Ltd., 20 Carlisle Rd., The Hyde, Hendon, London, N.W.9. T.: Colindale 8844. Lesto portable tools, etc.

Scottish Distributors, Ltd., Aeronautical and Scientific Division, 62 Shirland Rd., Maida Vale, London, W.9. T.: Cunningham 8080. Laboratory equipment; fuel-measuring equipment; engineers' hand and machine tools. Engineers' Tools Division; High-speed cutters, etc.

Skinners (Southampton), Ltd., Millbrook Trading Estate, Southampton. T.: Southampton 71167-8. Press tools, jigs and fixtures, gauges.

Talbot Tool Co., Ltd., 87 Borough High St., London, S.E.1. T.: Hop 3722 and 3310. Grip drill and reamer jig bushes; Nurogrip and Polygrip jig bushes, etc.

Turner Brothers (Birmingham) Ltd., Galvanic Works, Cliveland St., Birmingham, 19. T.: Aston Cross 1741. Press tools, jigs, fixtures and power presses.

Vactric (Precision Tools), Ltd., Vactric House, Sloane St., London, S.W.1. T.: Belgravia 7000. Precision tools, gauges, moulds, etc.

Vaughan, Edgar, and Co., Ltd., Legge St., Birmingham, 4. Oils, compounds and salts.

Ward, H. W., and Co., Ltd., Dale Rd., Birmingham, 29. Capstan and turret lathes.

Wickman, Ltd., Banner Lane, Tile Hill, Coventry. T.: Coventry 65231. Automatic lathes, tool-grinding machines; Wimet tools; dies, press tools, etc.

Williams and James (Engineers), Ltd., Chequers Bridge, Gloucester. T.: Gloucester 24021-3. Air compressors.

Wolf Electric Tools, Ltd., Pioneer Works, Hanger Lane, Esling, London, W.5. T.: Perivale 5631. Portable electric tools.

Young, A. S., and Co., Ltd., Tower Works, Woodside Lane, N. Finchley, London, N.12. T.: Hillside 6606-7. Oxy-acetylene welding and cutting equipment, rods and accessories.

5——Controls, Systems and Accessories

A.B.C. Motors, Ltd., Walton-on-Thames, Surrey. T.: Walton-on-Thames 774-5. Auxiliary power units; refuelling units for seaplanes, etc.

Amal, Ltd., Holdford Rd., Witton, Birmingham, 6. T.: Birchfields 4571. Ball and roller joints, flexible distance controls, float chambers, jet calibrating machines, flowmeters, injectors and carburetters.

Blocktube Controls, Ltd., Bicester Road, Aylesbury, Bucks. Mechanical controls.

Coventry Victor Motor Co., Ltd., Coventry. T.: Coventry 5054-6. Auxiliary powerplant prime movers and light aircraft engines.

Duval, S., and Sons, Ltd., 8-12 Wadsworth Rd., Greenford, Middx. T.: Perivale 7807-8. Precision engineering specialists in cyclic and other time-switch devices.

Dragonair, Ltd., Fitzherbert Rd., Farlington, Portsmouth. T.: Cosham 76451-3. Dragonfly heating and de-icing systems; Dragonair heating and ventilating systems.

Evershed and Vignoles, Ltd., Acton Lane Works, Chiswick, London, W.4. T.: Chiswick 3670. F.H.P. motors, servo amplifiers and flap positioners.

Godden, M. H. (Cheltenham), Ltd., Bouncers Lane, Cheltenham, Glos. T.: Cheltenham 7202-3. De-icing equipment.

Hale, Hamilton (Valves), Ltd., Frays Mill Works, Cowley Rd., Uxbridge, Middx. T.: Uxbridge 6525-6. Pressure reducing and solenoid valves; pressure-control equipment.

Trade Directory . . . .

Harvey Electronics, Ltd., 273 Farnborough Rd., Farnborough, Hants. T.: Farnborough 1120. Servo units, bulk erasers for magnetic tape; specialized electronic and electro-mechanical devices.

Keelavite Hydraulics, Ltd., Allesley, Coventry. T.: Meriden 441. Keelavite hydraulic pumps, motors, cylinders and control gear.

R.M.R. Engineering, Brook St., Tring, Herts. T.: Tring 3338. Pipe-line unions and cups.

Scottish Distributors, Ltd., Aeronautical and Scientific Division, 62 Shirland Rd., Maida Vale, London, W.9. T.: Cunningham 8080. Electric motors; air-pressure and vacuum pumps, etc.

Seton Creaghe Engineering Co. (1950), Ltd., Trading Estate, Park Royal Rd., London, N.W.10. T.: Elgar 5257-8. High-precision electro-mechanical devices and mechanisms.

Thermotank, Ltd., 150 Helen St., Glasgow, S.W.1. Air-conditioning plant.

T.K.S. (Aircraft De-icing), Ltd., Drayton House, Gordon St., London, W.C.1. T.: Euston 4650. De-icing systems and fluids.

Varley-FMC, Ltd., Ferry Lane, Brentford, Middx. T.: Ealing 1186. Pumping equipment; petrol dispensing units.

White, S. S., Dental Manufacturing Co. (G.B.), Ltd., The (Industrial Division), Britannia Works, St. Pancras Way, London, N.W.1. T.: Euston 5393. Torsional flexible remote controls and flexible shaft assemblies for engine speed indicators.

6—Instrument Equipment

Accurate Recording Instrument Co., Aric Works, Windsor Avenue, Merton, London, S.W.19. T.: Liberty 5661. Mechanical dial-type instruments and controls.

A.J.W. (Instruments), Ltd., The Drive, Horley, Surrey. T.: Horley 1420. Aircraft instruments.

Ancillary Developments, Ltd., Ancilco Works, Surrey Avenue, Camberley, Surrey. T.: Camberley 3443. Precision wirewound resistors and potentiometers.

Appleby and Ireland, Ltd., Kempshott House, nr. Basingstoke. T.: Basingstoke 2510. Aircraft and scientific instruments; pressure-responsive elements.

Avimo, Ltd., Taunton, Somerset. T.: Taunton 3634-5. A.S.I. pressure heads, pipe couplings for coolant, oil and fuel pipe lines; film assessors and analysers; electronic apparatus.

Barnet Instruments, Ltd., Bath Place, Barnet, Herts. T.: Barnet 0066. Pressure, vacuum and compound gauges, and testing equipment.

British Rototherm Co., Ltd., The, Merton Abbey, London, S.W.19. T.: Liberty 7661. Rototherm dial-type bi-metallic and distance-reading temperature gauges, temperature and pressure recorders.

Browne, Henry and Son, Ltd., Station Works, Barking, Essex. T.: Rippleway 4054-6. Sestrel aero compasses and other instruments.

Carter, B. and F., and Co., Ltd., Albion Works, Bolton, 17, Lancs. T.: Bolton 23344. Ratchet and revolution counters; speed indicators, measuring units, etc.

Cooke, Troughton and Simms, Ltd., Haxby Rd., York. T.: York 24112. Microscopes.

Counting Instruments, Ltd., 5 Elstree Way, Boreham Wood, Herts. T.: Elstree 1382. Mechanical and electro-magnetic counters, etc. Number wheels and pinions for aircraft instruments.

Dent and Co., and Johnson, Ltd., Linwood, Renfrewshire. T.: Johnstone 109. Dent-Johnson compasses, etc.

Greenwood, P. W. (Willesden), Ltd., 62 Shirland Rd., London, W.9. T.: Cunningham 4422. Blind-flying and navigational instruments.

K.D.G. Instruments, Ltd., Manor Royal, Crawley, Sussex. T.: Crawley 25151. Aircraft instruments.

Kent, George, Ltd., Biscot Rd. Luton, Beds. T.: Luton 2440. Flow meters, etc.

Langham Thompson, J., Ltd., 176 High Rd., Bushey Heath, Herts. T.: Bushey Heath 2411. Pressure transducers, accelerometers, etc.

Measuring Instruments (Pullin), Ltd., Electrin Works, Winchester St., Acton, London, W.3. T.: Acorn 4651. Electrical indicating instruments, relays, test and control gear.

Munro, R. W., Ltd., Cline Rd., Bounds Green, London, N.11. T.: Enterprise 4422. Flight-record instruments, indicators and gauges.

Page Engineering Co. (Sunbury-on-Thames), Ltd., Page Works, Forge Lane, Sunbury-on-Thames, Middx. T.: Sunbury-on-Thames 4242. Moving-coil relays, measuring instruments, thermometers, etc.

Painton and Co., Ltd., Kingsthorpe, Northampton. T.: Northampton 34251. Electrical components.

Power Flexible Tubing Co., Ltd., The, Derby Works, Vale Rd., Finsbury Park, London, N.4. T.: Stamford Hill 6696. Flexible metallic bellows; temperature-control apparatus, fuel pumps.

Reid and Sigrist, Ltd., Braunstone Works, Braunstone, Leicester. T.: Leicester 88101-4. Aeronautical instruments; specialists in gyroscopic instruments and test gear.

Rotameter Manufacturing Co., Ltd., 602 Purley Way, Croydon, Surrey. T.: Croydon 3816. Flow meters.

Roxton Instruments, Ltd., Canada Rd., Oyster Lane, Byfleet, Surrey. T.: Byfleet 42211. Data recording, handling and processing equipment. Midas magnetic tape-recorders.

Scottish Distributors, Ltd., Aeronautical and Scientific Division, 62 Shirland Rd., Maida Vale, London, W.9. T.: Cunningham 8080. Gyro and meteorological instruments, solenoids, simulator equipment.

Stanley, W. F., and Co., Ltd., Avery Hill Rd., New Eltham, London, S.E.9. T.: Eltham 3836. Instruments.

Test Equipment, Ltd., Gatwick Rd., Crawley, Sussex. T.: Crawley 2350. Gyroscopic instruments and research equipment.

H. Tinsley and Co., Ltd., Werndee Hall, South Norwood, London, S.E.25. Precision electrical measuring instruments.

Williams and James (Engineers), Ltd., Chequers Bridge, Gloucester. T.: Gloucester 24021. Reducing valves and pressure regulators; W. and J. "Pneumerstat."

Wynstruments, Ltd., Staverton Aerodrome, Gloucester. T.: Churchdown 3264. Control and instrumentation engineers.

7—Radio and Electrical Equipment

Aerocontacts, Ltd., Gatwick Airport, Horley, Surrey. T.: Horley 4455. Electrical and radio equipment.

Aeronautical Radio Services, Ltd., Doman Rd., Camberley, Surrey. T.: Camberley 2341. Aircraft radio and radar.

Air Transport (Charter) (C.I.), Ltd., 7 Willow Rd., Poyle Trading Estate, Colnbrook, Bucks. T.: Colnbrook 2654-6. Electronic workshop and field test equipment.

Amphenol-Borg, Ltd., Victoria Rd., Burgess Hill, Sussex. T.: Burgess Hill 85616. Electronic and electrical components.

Anticoustic Co., The, 7 Millmead, Guildford, Surrey. T.: Guildford 66488. Electrical and electronic equipment; ear defenders and sound insulators; acoustic booths and sound-proof cabinets.

Automatic Coil Winder and Electrical Equipment Co., Ltd., 92-96 Vauxhall Bridge Rd., London, S.W.1. T.: Victoria 3404. Electrical and electronic test equipment; coil-winding machines.

Bonella, D. H., and Son, Ltd., West Hill, Hoddesdon, Herts. T.: Hoddesdon 2283. Electrical accessories.

British Electric Resistance Co., Ltd., Queensway, Enfield, Middx. T.: Howard 2411. Auto-transformers, resistances, rheostats, potentiometers, etc

Butlers, Ltd., Atlantic Works, Grange Rd., Small Heath, Birmingham, 10. T.: Victoria 3491-6. Lamps; marker lights.

Cathodeon Crystals, Ltd., Linton, Cambs. Quartz crystal units.

Cathodeon, Ltd., Church St., Cambridge. T.: Cambridge 56481. Fire-protection and high-voltage high-speed evacuated relay switches.

C. P. Clare, Ltd., 70 Dudden Hill Lane, Willesden, London, N.W.10. Electro-magnetic relays.

C.W.C. Equipment, Ltd., Acorn Works, Kings Grove, Maidenhead, Berks. T.: Maidenhead 2275. Toggle switches and connectors; wiring systems.

Davis and Timmins (Aircraft), Ltd., 270 High Rd., Ilford, Essex. T.: Ilford 3460. Electrical parts and cabin lamps.

"Diamond H" Switches, Ltd., Gunnersbury Av., London, W.4. T.: Chiswick 6444. Miniature hermetically sealed aircraft-type relays, rotary and toggle switches and thermostats and energy regulators.

Electrical and Refrigeration Services, Ltd. (E.R.S. (London), Ltd.), Brookwood Rd., London, S.W.18. Radio connectors, etc.

Electronic Components, Weedon Rd., Industrial Estate, Northampton. T.: Northampton 2467. Faders, attenuators, switches, etc.

Evershed and Vignoles, Ltd., Acton Lane Works, Chiswick, London, W.4. T.: Chiswick 3670. Electrical controls and test sets.

Fairey Marine, Ltd., Hamble, nr. Southampton, Hants. T.: Hamble 2135. Radomes.

Greenwood, P. W. (Willesden), Ltd., 62 Shirland Rd., London, W.9. T.: Cunningham 4422. Electrical components and accessories.

Harvey Electronics, Ltd., 273 Farnborough Rd., Farnborough, Hants. T.: Farnborough 1120. Servo mechanisms, power-supply units, etc.

International Aeradio, Ltd., 40 Park St., London, W.1. T.: Hyde Park 5024. Telecommunications, radio and radar aids.

Land, Air and Sea Instruments Co., Ltd., 328 Grand Buildings, Trafalgar Sq., London, W.C.2. T.: Whitehall 4864. Lascom aircraft radio communication and navigation equipment; VHF radio telephones.

Lyon, Arthur, and Co. (Engineers), Ltd., 6 Carlos Place, Grosvenor Sq., London, W.1. T.: Hyde Park 9141. Generator test benches and inverter testers.

Magnetic Devices, Ltd., Exning Rd., Newmarket. T.: Newmarket 3181. Relays, contactors, solenoids, connectors, rotary transformers; production of items manufactured by Power Controls, Ltd.

Nife Batteries, Redditch, Worcs. T.: Redditch 157. Nife nickel cadmium alkaline batteries for telemetry, guidance and alarm systems, guided missile control.

N.S.F., Ltd., 9 Stratford Place, London, W.1. T.: Langham 9561. N.S.F.-Oak and Cutler hammer switches, etc.

Page Engineering Co. (Sunbury-on-Thames), Ltd., Page Works, Forge Lane, Green St., Sunbury-on-Thames, Middx. T.: Sunbury-on-Thames 4242-4. Switches; sealed relays; indicator lamps; lamp and fuse holders.

Painton and Co., Ltd., Kingsthorpe, Northampton. T.: Northampton 34251. Attenuators and faders; switches; terminals, plugs and sockets; wire-wound potentiometers, midget RF chokes, etc.

Piezo, Ltd., 26 St. Albans Rd., Watford, Herts. T.: Watford 27808. Quartz crystals for radio frequency control.

Racal, Ltd., Western Rd., Bracknell, Berks. T.: Bracknell 941. Electronic equipment.

Rist's Wires and Cables, Ltd. Lower Milehouse Lane, Newcastle, Staffs. T.: Newcastle 69212-4. Cable and cable assemblies and looms etc.

Santon, Ltd., Somerton Works, Newport, Mon. T.: Newport 71211. Rotary switches, etc.

Scottish Distributors, Ltd., Aeronautical and Scientific Division, 62 Shirland Rd., Maida Vale, London, W.9. T.: Cunningham 8080. General electrical equipment; plugs, switches, etc.

Siemens Edison Swan, Ltd., 155 Charing Cross Rd., London, W.C.2. T.: Gerrard 8660. Electrical cables; telecommunications, signal and lighting equipment.

Simon Equipment, Ltd., 48-50 George St., Portman Sq., London, W.1. T.: Welbeck 2371. Magnetic monitoring equipment, timing injector units, etc.

Technograph Printed Circuits, Ltd., 32 Shaftesbury Avenue, London, W.1. T.: Gerrard 4532. Printed circuits.

Walters Electrical Mfg. Co., Ltd., Kensal Road, London, W.11. Passenger service panels and warning notices, etc.

8—Survival Equipment and Flying Clothing

Airborne Service Equipment, Ltd., Arterial Rd., Southend-on-Sea, Essex. T.: Eastwood 55265. Parachutes; air/sea rescue packs. R.A.F. web equipment, kitbags, haversacks.

Beaufort (Air-Sea) Equipment, Ltd., Victoria Rubber Works, Newton Heath, Manchester, 10. T.: Failsworth 1166. Air/sea rescue equipment, marine and flying equipment.

Black and Decker, Ltd., Harmondsworth, Middx. T.: Skyport 2411-9. Air-rescue saws.

British Parachute Co., Ltd., Chapeltown St., Manchester, 1. T.: Ardwick 2414. Parachutes; general aircraft safety equipment.

Fairey Marine, Ltd., Hamble, nr. Southampton, Hants. T.: Hamble 2135. Folding dinghies.

Helmets, Ltd., Moat Factory, Wheathampstead, Herts. T.: Wheathampstead 2221-3. Protective headwear and ancillary equipment.

Lea Bridge Industries, Ltd., (Aircraft Section), Priory Works, Arterial Rd., Southend-on-Sea. T.: Eastwood 525265. Air/sea rescue equipment, parachutes, Lindholme gear, etc.

Lewis, D., Ltd. (Dept. F.), 124 Gt. Portland St., London, W.1. T.: Museum 4314. Flying suits, goggles and gloves. Oxygen equipment.

Permutit Co., Ltd., The, Permutit House, Gunnersbury Av., London, W.4. T.: Chiswick 6431. Drinking-water filters; de-salting kits.

Rumboid, L. A., and Co., Ltd., Kingsgate Place, Kilburn, London, N.W.6. T.: Maida Vale 7366-7-8. Lifebelts, stretchers and folding invalid-carrying chairs.

Vosper, Ltd., P.O. Box No. 18, Portsmouth, Hants. T.: Cosham 79481. Seaplane and crash rescue tenders; fireboats; air/sea rescue launches; airborne lifeboats.

WAECO, Ltd., High Pool, Salisbury, Wilts. Marine distress signals and line-carrying rockets

Trade Directory . . . .

9——*Miscellaneous Equipment and Services*

A.B.C. Motors, Ltd., Walton-on Thames, Surrey. T.: Walton-on-Thames 774-5. Auxiliary power units pumping and generating sets; bilging and refuelling units for seaplanes.

Abbey Panel and Sheet Metal Co., Ltd., Bayton Rd., Exhall, nr. Coventry. T.: Bedworth 2071. Prototype and experimental work.

Aerogalley, Ltd. (Proprietors: Aerocontacts (Aircraft Distributors), Ltd.), Gatwick Airport, Surrey. T.: Horley 4455. Aircraft catering equipment.

Aerolex, Ltd., Bridge Rd., Camberley, Surrey. T.: Camberley 1500. Quick-release lashing equipment; stretcher equipment; safety belts.

Airborne Service Equipment, Ltd., Arterial Rd., Southend-on-Sea, Essex. T.: Eastwood 55265. R.A.F. banner and drogue targets; aircraft furnishings; kapok cushions.

Airpak, Ltd., 76 Grosvenor St., London, W.1. T.: Mayfair 3467; and Overton, Hants. T.: Overton 259. Upholstery and insulation materials; Tropal and Tropaline.

Airwork Services, Ltd., 35 Piccadilly, London, W.1. T.: Regent 8494. Aircraft servicing, maintenance, etc.

Aviation Traders, Ltd., 21 Wigmore St., London, W.1. T.: Museum 7791; Southend Airport, Essex. T.: Rochford 56491; and Stansted Airport, Essex. T.: Takeley 391. Experimental design and production; airframe and engine repair.

British Replin, Ltd., 2 South Audley Street, London, W.1. T.: Grosvenor 6692. Special long-wear fire-resistant upholstery fabrics.

Brooklands Aviation, Ltd., Weybridge, Surrey. Repair and overhaul of civil and military aircraft.

Bury Felt Manufacturing Co., Ltd., Hudcar Mills, Bury, Lancs. Upholstery, carpeting, felts, strips, gaskets, washers and plastic foam.

Camerer Cuss and Co., 54-56 New Oxford St., London, W.1. T.: Museum 8968-9. Aircraft clocks.

Cox, John and Son, Ltd., Coxorian Works, Carlisle Road, London, N.W.9. T.: Colindale 4001. Aircraft cloth and trimming.

Cullum Detuners, Ltd., 58 Highgate West Hill, London, N.6. T.: Fitzroy 1221. Test-bed silencing, mufflers, intake splitter systems, run-up pens.

Elsan Manufacturing Co., 51 Clapham Rd., London, S.W.9. Toilet units and chemical fluids.

Fairey Marine, Ltd., Hamble, nr. Southampton, Hants. T.: Hamble 2135. Target conversions.

Fisons Pest Control, Ltd., Harston, Cambs. Pest control.

Harper, C. E., Aircraft Co., Ltd., Exeter Airport, Clyst Honiton, Devon. T.: Exeter 67451. Aircraft service and maintenance.

Ilford, Ltd., Ilford, Essex. T.: Ilford 3000. Photographic sensitized materials, equipment and chemicals.

International Aeradio, Ltd., 40 Park St., London, W.1. T.: Hyde Park 5024. Maps and map mountings. Aerad flight guides; route manuals, air-mileage handbooks, etc.

Kodak, Ltd., Kodak House, Kingsway, London, W.C.2. T.: Holborn 7841. Photographic equipment.

London Nameplate Manufacturing Co., Ltd., The, Zylo Works, Brighton, Sussex. T.: Brighton 67025. Nameplates, navigational instruments.

Mallock-Armstrong Co., The, Sussex House, 204 High St., Guildford, Surrey. T.: Guildford 66488. Ear defenders.

Mason, E. N., and Sons, Ltd., Arc-light Works, Colchester, Essex. T.: Colchester 5191. Photo-copying and drawing-office equipment.

Mavitta Drafting Machines, Ltd., Highlands Rd., Shirley, nr. Birmingham. T.: Solihull 2231. Drawing-office equipment.

M.B. Packaging, Ltd., North Rd., Lancing, Sussex. T.: Lancing 3421. Government and export packers. Designers and packers of aircraft equipment.

Middleton Sheet Metal Co., Ltd., Spring Vale Works, Middleton, Manchester. T.: Middleton 2427-8. Navigators' tables and seats.

Power Jets (Research and Development), Ltd., 25 Green St., London, W.1. T.: Mayfair 7801. Management of gas-turbine patents; consultants.

Rumbold, L. A. and Co., Ltd., Kingsgate Pl., Kilburn, London, N.W.6. T.: Maida Vale 7366-7-8. Aircraft seating, furnishing and soundproofing specialists.

Samlesbury Engineering, Ltd., Samlesbury Airfield, nr. Blackburn, Lancs. T.: Blackburn 44668. Drawing-office services; airframe and engine overhaul, servicing and maintenance; seats; packaging, etc.

Taylor, C. F. (Metal Workers), Ltd., Molly Millars Lane, Wokingham, Berks. T.: Wokingham 1005-6. Aircraft galley, heating, toilet and ventilating equipment.

Technical Platings, Ltd., Craigs Works, Luther Road, Teddington, Middx. Anti-corrosion finishes.

Test Equipment, Ltd., Gatwick Rd., Crawley, Sussex. T.: Crawley 2350. Wind-tunnel balances, manometers, high- and low-speed models.

Thermotank, Ltd., Helen St., Glasgow, S.W.1. T.: Govan 2444. Plastic and metal punkah louvres.

Transport Seating, Ltd., Western Works, Bromley Street, Birmingham, 9. T.: Victoria 5901-3. Aircraft seats, furnishing and escape chutes.

10——*Airport Construction and Equipment*

Aerocontacts (Ground Equipment), Ltd., Gatwick Airport, Horley, Surrey. T.: Horley 4455. Airport ground-handling equipment; air-conditioning equipment; wheel chocks, stands and jacks.

Airborne Service Equipment, Ltd., Arterial Rd., Southend-on-Sea, Essex. T.: Eastwood 55265. Aircraft weatherproof covers; portable hangars.

Airfoam Fire Protection, Ltd., 166 Victoria St., London, S.W.1. T.: Victoria 3121. Crash tenders, foam pumps, etc.

Angus, George, and Co., Ltd., Angus House, Newcastle upon Tyne. T.: Newcastle upon Tyne 22656-9. Fire-fighting equipment and clothing.

Austinlite, Ltd., Crawley, Sussex. Automatic stand-by generating sets; radar installations.

Aviation Traders, Ltd., 21 Wigmore St., London, W.1. T.: Museum 7791; Southend Airport, Essex. T.: Rochford 56491; and Stansted Airport, Essex. T.: Takeley 391. Hangarage: airport freight-handling equipment.

Bellman Hangars, Ltd., Terminal House, Grosvenor Gardens, London, S.W.1. T.: Sloane 5259. Hangars, large-span buildings and unit construction.

Bolton Gate Co., Ltd., Waterloo St., Bolton, Lancs. T.: Bolton 4240. Bolton top-hung power-operated doors; shutter doors and collapsible gates.

Ceag, Ltd., Queens Rd., Barnsley, Yorks. T.: Barnsley 2208. Aerodrome floodlight lamps.

Central Rediffusion Services, Ltd., Lower Regent St., London, S.W.1. T.: Whitehall 0221 and 8202. Public-address systems and Rediffusion wired broadcasting service.

Conveyancer Fork Trucks, Ltd., Liverpool Rd., Warrington, Lancs. T.: Warrington 35241. Fork-lift trucks; electric tractors and load-handling equipment.

Coseley Engineering Co., Ltd., Dock Meadow Drive, Lanesfield, Wolverhampton. T.: Bilston 41927-9. Prefabricated hangars, etc.

Costain, Richard, Ltd., 111 Westminster Bridge Road, London, S.E.1. T.: Waterloo 4977. Building and civil-engineering contractors.

Coventry Climax Engines, Ltd., Widdrington Rd., Coventry. T.: Coventry 62607. Fork-lift trucks and trailer fire pumps.

Douglas Equipment, Ltd., Kingsditch Lane, Tewkesbury Road, Cheltenham, Glos. T.: Cheltenham 56361-2-3. Tugmaster aircraft-towing tractors.

Dutton, H. W., and Co., Ltd., 25 Victoria St., London, S.W.1. T.: Abbey 1822. Heating and ventilation.

Esavian, Ltd., Esavian Works, Stevenage, Herts. T.: Stevenage 500. Sliding and folding aluminium doors.

Fire Armour, Ltd., 9 George St., London, W.1. T.: Welbeck 3313. Crash tenders, fire-fighting and rescue vehicles; pumps, etc.

Hawksley, S. M. D., Ltd., Buckingham Ave., Slough, Bucks. T.: Slough 23212. Aluminium hangars, nose docks, etc.

Head Wrightson Aluminium, Ltd., Teesdale Iron Works, Thornaby-on-Tees. Yorks. Light-alloy hangars and aircraft-handling equipment.

Heston Aircraft and Associated Engineers, Ltd., Heston Airport, Hounslow, Middx. T.: Hayes 3844. Passenger steps.

I.T.D., Ltd., Webb Lane, Hall Green, Birmingham, 28. T.: Springfield 2282. Stacatruc fork-lift trucks; Electricar platform trucks; Powrworker platform, pallet and fork-lift trucks; Portapal pallet transporters.

Laing, John, and Sons, Ltd., Bunns Lane, London, N.W.7. T.: Mill Hill 3636. Airbase construction.

Lansing Bagnall, Ltd., Kingsclere Rd., Basingstoke, Hants. T.: Basingstoke 1010. Fork-lift trucks, tractors and trailers.

Loadex, Ltd., Anerley Works, 207 Anerley Rd., London, S.E.20. T.: Sydenham 3111. Aerodrome signalling equipment, lighting, beacons.

Macks Structures (London), Ltd., Bank Buildings, Waltham Green, London, S.W.6. T.: Fulham 7233. Bellman and blister hangars, Nissen huts and sectional timber buildings.

Mercury Airfield Equipment, Ltd., The Quay, Gloucester. T.: Gloucester 24451-2. Diesel and petrol-engined tractors for towing aircraft and handling baggage; maintenance docks, steps and platforms; elevating platform trucks, trailers.

Merryweather and Sons, Ltd., Greenwich High Rd., London, S.E.10. T.: Tideway 1016. Fire-fighting equipment; extendable servicing platforms.

New Welbeck, Ltd., Moulsecoomb Way, Brighton, 7. T.: Brighton 61666. Vacuum cleaners, blowers and sprayers.

Petbow, Ltd., Sandwich, Kent. T.: Sandwich 3311. Aircraft ground-servicing power plant; automatic stand-by generating plant; aircraft starting and towing units.

Red Devon, Ltd., Seymour Wharf, Totnes, S. Devon. T.: Totnes 3282. Aircraft starting units, static and mobile greasing sets.

Ransomes Sims and Jefferies, Ltd., Orwell Works, Ipswich. T.: Ipswich 54711. Aerodrome preparation and maintenance machinery.

Rotorports, Ltd., Kent House, 87 Regent Street, London, W.1. T.: Regent 3524. Developers of helicopter services and city-centre landing sites in U.K.

Samlesbury Engineering, Ltd., Samlesbury Airfield, nr. Blackburn, Lancs. T.: Blackburn 44668. Hangarage; assembly and maintenance platforms and stagings, etc.

Short and Mason, Ltd., Aneroid Works, 280 Wood St., Walthamstow, London, E.17. T.: Coppermill 2203-4. Wind-speed and direction indicators; special aneroid barometers for control towers.

Siemens Edison Swan, Ltd., 155 Charing Cross Rd., London, W.C.2. T.: Gerrard 8660. Airfield lighting equipment.

Smiths of Stockport, Ltd., 205-207 Wellington Rd. South, Stockport. T.: Stockport 4642. Airborne and ground equipment.

Spurling Motor Bodies, Ltd., Edgware Rd., The Hyde, London, N.W.9. T.: Colindale 7171. Aircraft stairways.

Steel Barrel Co., Ltd., The, Phœnix Works, Uxbridge. Middx. T.: Uxbridge 8535-8. Aircraft fuellers and servicers.

Steels Engineering Products, Ltd., Crown Works, Sunderland. T.: Sunderland 56281. Coles mobile cranes.

Stone-Chance, Ltd., Crawley, Sussex. T.: Crawley 25251. Aerodrome lighting equipment.

Tannoy, Ltd., 348 Norwood Rd., West Norwood, London, S.E.27. T.: Gipsy Hill 1131. Tannoy equipment and systems.

Taylor, C. F. (Metal Workers), Ltd., Molly Millars Lane, Wokingham, Berks. T.: Wokingham 1005-6. Aircraft servicing trolleys; towable and self-propelled passenger steps.

Thompson Bros. (Bilston), Ltd., Bilston, Staffs. Refuelling equipment.

Transport Equipment (Thornycroft), Ltd., Thornycroft House, Smith Square, London, S.W.1. T.: Abbey 8000. High-performance chassis for crash tenders.

Vosper, Ltd., P.O. Box 18, Portsmouth, Hants. T.: Cosham 79481. Refuelling launches.

Wayne Tank and Pump Co., Ltd., Western Road, Bracknell, Berks. Fuel storage, pumping and measuring equipment.

Westland Engineers, Ltd., Yeovil, Somerset. Specialized doors and actuating gear.

Williams and James (Engineers), Ltd., Chequers Bridge, Gloucester. T.: Gloucester 24021. Air and oil-free compressors; two-stage compressors and three-stage sets for aircraft ground servicing.

Wimpey, George and Co., Ltd., Hammersmith Grove, London, W.6. T.: Riverside 2000. Airfield construction.

Y.S.C., Ltd., The, 45-47 Copeland Rd., London, S.E.15. T.: New Cross 6113. Very cartridges, Holt flares.

11——*Fuels and Oils*

Acheson Colloids, Ltd., P.O. Box 12, Prince Rock, Plymouth, Devon. T.: Plymouth 66351. Dispersions of "dag" colloidal graphite and colloidal molybdenum disulphide.

British Oxygen Co., Ltd., The, Bridgewater House, Cleveland Row, London, S.W.1. T.: Whitehall 9777. Liquid-oxygen rocket fuel oxidant.

Castrol, Ltd., Castrol House, Marylebone Road, London, N.W.1. T.: Hunter 4455. Aero lubricants; Castrol and Castrolaero oils and greases.

Duckham, Alexander, and Co., Ltd., Hammersmith, London, W.6. T.: Fulham 3300. Lubricants.

Gulf Oil (Great Britain), 6-7 Grosvenor Pl., London, S.W.1. T.: Belgravia 5011. Lubricants and cutting oils.

Laporte Chemicals, Ltd., Luton, Beds. T.: Luton 4390. H.T.P. rocket fuel oxidant.

Mobil Oil Co., Ltd., Caxton House, Westminster, London, S.W.1. T.: Whitehall 1010. Aircraft engine oils, Mobil Aero fluids, Mobil greases and Mobil industrial and automotive lubricants.

Ragosine Oil Co., Ltd., Rocol House, Swillington, Leeds. T.: Garforth 2261. Lubricants.

Regent Oil Co., Ltd., 117 Park St., London, W.1. T.: Mayfair 8474. Regent and Caltex products.

Sternol, Ltd., Royal London House, Finsbury Sq., London, E.C.2. T.: Monarch 3871. Soluble, straight-cutting, quenching and rust-preventive oils.

Vacuum Oil Co., Ltd., Caxton House, Westminster, London, S.W.1. T.: Whitehall 1010. Mobiloil Aero aero-engine oils, fluids and specialities; Mobilgreases.

Vaughan, Edgar, and Co., Ltd., Legge St., Birmingham, 4. Oils and compounds for metal working, heat-treatment oils and salts.

Trade Directory . . . .

12——Paints, Cleaners and Finishing Processes

Acorn Anodising Co., Ltd., Durham Rd., Boreham Wood, Herts. T.: Elstree 5433. Anodisers.

Alumilite and Alzak, Ltd., Station Rd., Merton Abbey, London, S.W.19. T.: Liberty 7641. Anodising, electro-brightening; decorative finishes.

Bennett (Hyde), Ltd., Boston Mills, Hyde, Cheshire. T.: Hyde 1377-9. Gunk D.P. solution and H.S. hydro-seal decarbonizing compound; degreasants.

Berk, F. W., and Co., Ltd., Brent Crescent, North Circular Rd., London, N.W.10. T.: Elgar 3533. Abrasives; building-up equipment; metal spraying and equipment, etc. Schori process.

Blundell, Spence and Co., Ltd., Industrial Division, York House, 37 Queen Square, London, W.C.1. T.: Chancery 6877. Vulcan transport finishes and Offkwik paint remover.

Fletcher, Miller, Ltd., Alma Mills, Hyde, Cheshire. Flick easing oil; Rodol rust preventives; Solvex degreasing compound; liquid Solvex cleaning agent.

Goddard, J., and Sons, Ltd., Nelson St., Leicester. T.: Leicester 23978. Plastic and aluminium polish; lapping media.

Hadfields (Merton), Ltd., Western Rd., Mitcham, Surrey. T.: Mitcham 3422. Enamels, paints, varnishes and lacquers; decorative finishes.

Northey Rotary Compressors, Ltd., 200-202 Alder Rd., Parkstone, Poole, Dorset. T.: Parkstone 4900. Oil-free compressors for electro-plating, metal finishing, polishing and spray-painting plants.

Parkes, L. B., and Co., Ltd., 16 Station St., Walsall. T.: Walsall 4546. Anodising, cadmium plating, Parkerizing and general metal finishing.

Rozalex, Ltd., 10 Norfolk St., Manchester, 2. T.: Blackfriars 1122. Rozalex barrier creams and cleansers.

Sternol, Ltd., Royal London House, Finsbury Square, London, E.C.2. T.: Monarch 3871. Barrier creams and hand cleansers.

Union Oxide and Chemical Co., Ltd., Unichem House, 6 Eldon St., London, E.C.2. T.: Bishopsgate 6741. Chromic acid.

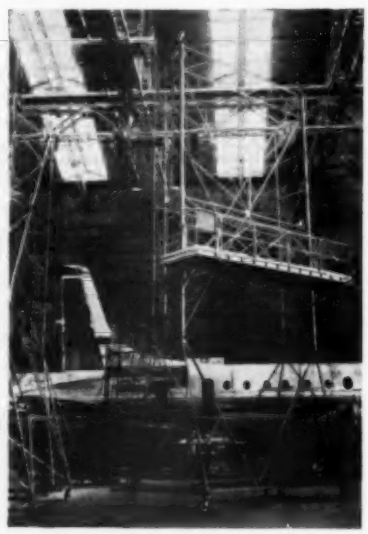
Walterisation Co., Ltd., Waddon Marsh Way, Purley Way, Croydon, Surrey. T.: Croydon 2791. Metal-finishing processes; phosphate paint-bonding and rust-proofing treatments. Rust removers and solvents. Alkaline-chromatic oxidation process.

Young, A. S., and Co., Ltd., Tower Works, Woodside Lane, N. Finchley, London, N.12. T.: Hillside 6606-7. Hard-surfacing process for landing skids, arrester gear, etc.

Industry Record

Mobile Adjusting Staging

For servicing Britannia tail units Bristol Aircraft have built a mobile adjustable staging rig. Powered by a modified Atlas Copco air hoist, it has a main framework of tubular construction mounted on a rectangular base, comprising rolled steel channel sections on lockable castor wheels.



Powered by an Atlas Copco air hoist, this mobile adjustable staging rig has been built by Bristol Aircraft for servicing Britannia tail units.

Vertical guide rails are built into the main frame and form the tracks on which a horizontal platform is raised and lowered. At the top of each guide rail is fitted a pulley over which pass the main lifting cables. By means of two additional pulleys the main cables are brought together and attached to the safety hook of a single block, which hangs in an inverted position.

Beneath this block, and attached to the main base frame, is the Atlas Copco air hoist. One end of the winching cable is attached to the side of the hoist and the other is led up to and over the pulley block, after which it is attached to the winding drum. The operation of the air hoist is by means of hand chains and cables passing over fairleads and pulleys.

Adjustable cut-down stops are incorporated in the mechanism of the air hoist and these come into action when the platform reaches the top or bottom of its travel, thus preventing over-running. Should the air supply to the hoist be cut off the motor will stop and its internal brake will prevent the cable drum from rotating. All moving parts, the hoist and its controls are guarded so that the platform can only be raised or lowered by the operator on the platform.

Publications Received

ABC Helicopters. An up to date and thoroughly comprehensive review of all current and projected helicopters, VTOL machines and GEMs, with a photograph, specification and description of each. By John W. R. Taylor. 64 pp., 4¼ in. by 7¼ in. Illustrated. Ian Allan, Ltd. Price 2s. 6d.

Advances in Space Science Vol II. Six chapters covering space physics, tracking, materials, plasma and electrostatic propulsion systems and attitude control, contributed by U.S. space experts. Edited by Frederick I. Ordway, III, of N.A.S.A. 450 pp., 6 in. by 9 in. Illustrated. Published by Academic Press Inc. (London), Ltd. Price $13.

Aero-thermodynamics and Flow in Turbomachines.—A text book designed to provide a sound understanding of flow phenomena in turbomachines, starting with basic physical theory and using vector- and tensor-analysis to establish fundamental flow relations. By Michael H. Vavra, professor in the Department of Aeronautics, U.S. Naval Postgraduate School. 632 pp.; 6 in. by 9¼ in. Illustrated. John Wiley and Sons, Inc. Price 116s.

The Battle of Britain.—The second new account in three months of the last great air battle of the classic kind; based on official documents and personal reminiscences and written for popular consumption. By Edward Bishop. 260 pp.; 5¼ in. by 8¾ in. Illustrated. George Allen and Unwin, Ltd. Price 21s.

The Aeroplane. An Historical Survey. A significant contribution to the recorded history of the aeroplane, published as a Science Museum handbook and including, in addition to a narrative historical survey, a commentary on some controversial claims in the light of new evidence. By Charles H. Gibbs-Smith. 376 pp. 6 in. by 9¼ in. Illustrated. H.M.S.O. Price £1 15s.

Aviation Calendar

Sept. 5

Farnborough.—S.B.A.C. Air Show; until Sept. 11.

Sept. 8

Varenna, Italy.—AGARD and Lomard Institute of Science and Letters Seminar on "Propulsion for Astronautics"; until Sept. 12.

Sept. 9

Cranfield.—International Rally organized by the Popular Flying Association; until Sept. 12.

Sept. 12

Zurich.—International Congress of Aeronautical Sciences; until Sept. 16.

Sept. 14

London.—Ultra Anniversary lecture, "The Evolution of Instrumentation," by Prof. A. Porter, in the Recital Room, Royal Festival Hall.

Sept. 16

Oxford.—Institute of Transport Week-end Course at New College; until Sept. 19.

Sept. 17

Battle of Britain "At Home" day. Twenty-five R.A.F. stations are open to the public.

Sheffield.—Norton Air Show.

Sept. 18

Boston, Lincs.—Battle of Britain Sunday.

Sept. 25

Dunstable Downs.—National Aerobatic Contest organized by the London Gliding Club, at 11.00 hrs.

Sept. 27

London.—The Institution of Mechanical Engineers Symposium on Automatic Control; until Sept. 28.

Sept. 28

London.—Society of Environmental Engineers lecture, "The Development and Testing of Small Electronic Components," at Imperial College, S.W.7, at 18.00 hrs.

London.—Northampton College of Advanced Technology start of 1960-61 session of post-graduate lectures in Aeronautical Engineering, at the College, St. John Street, E.C.1. Full details can be obtained from the College.

New Patents

APPLICATIONS ACCEPTED

851,273.—**Power Jets (Research and Development), Ltd.**—"Aircraft air intakes."—Apr. 14, 1959. (Apr. 23, 1958.)

851,352.—**Hartman, E.**—"Ornithopters."—Jne. 28, 1957. (Jne. 28, 1956.)

851,319.—**Soc. Nationale d'Etude et de Construction de Moteurs d'Aviation.**—"Jet propulsion nozzles having variable cross-sectional area."—Aug. 6, 1958. (Sept. 16, 1957.)

851,349.—**Rolls-Royce, Ltd.**—"Mountings, couplings and like devices."—Oct. 27, 1955. (Nov. 1, 1954.)

Printed specifications of the above will be available on Oct. 12, 1960, and the opposition period will expire on Jan. 12, 1961.

Personal Notices

BIRTHS

Arscott.—On Aug. 13, at R.A.F. Hospital, Ely, to Janet (*née* Knibbs), wife of Sqn. Ldr. Richard Arscott—twin daughters.

Cairns.—On Aug. 12, at R.A.F. Hospital, Ely, to Jessie (*née* Davidson), wife of Flt. Lt. D. S. Cairns—a son.

Lloyd.—On Aug. 10, at R.A.F. Hospital, Changi, Singapore, to Barbara (*née* Ford), wife of Flt. Lt. James B. Lloyd—a daughter.

Noakes.—On Aug. 15, at Catterick Military Hospital, to Joan, wife of Sqn. Ldr. the Rev. Ronnie Noakes—a daughter.

Tabor.—On Aug. 17, at R.A.F. Hospital, Akrotiri, Cyprus, to Shiona, wife of Flg. Off. A. S. Tabor—a daughter.

DEATH

Peterson.—On Aug. 16, Gp. Capt. F. H. Peterson, M.B.

represented a seven inch sphere of liquid oxygen, it would be equal to 2,500 gaseous litres. At 40,000 feet, this would be enough to provide a pilot with 14 hours of breathing.

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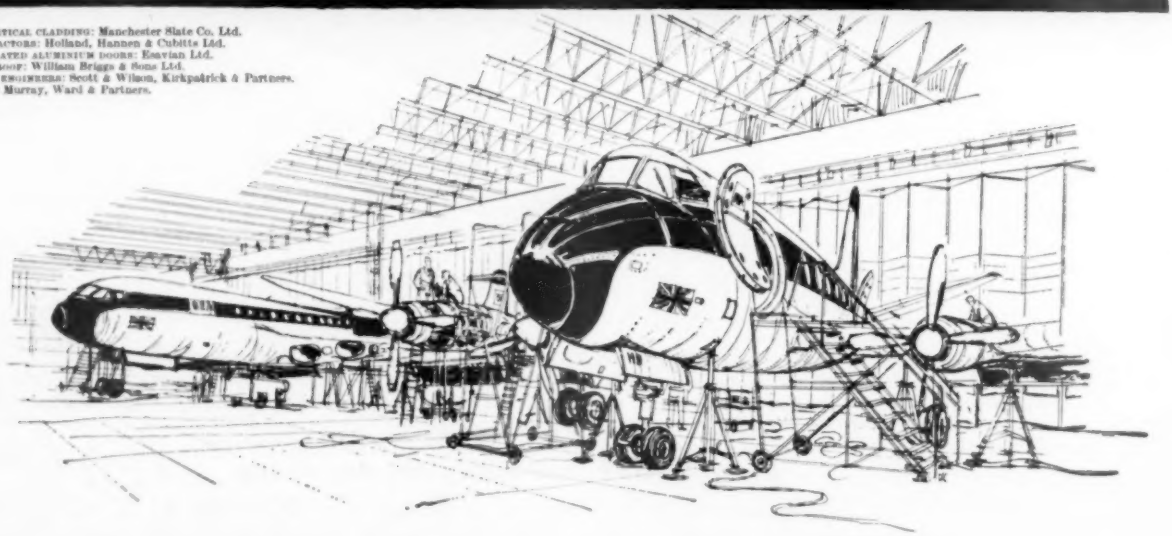

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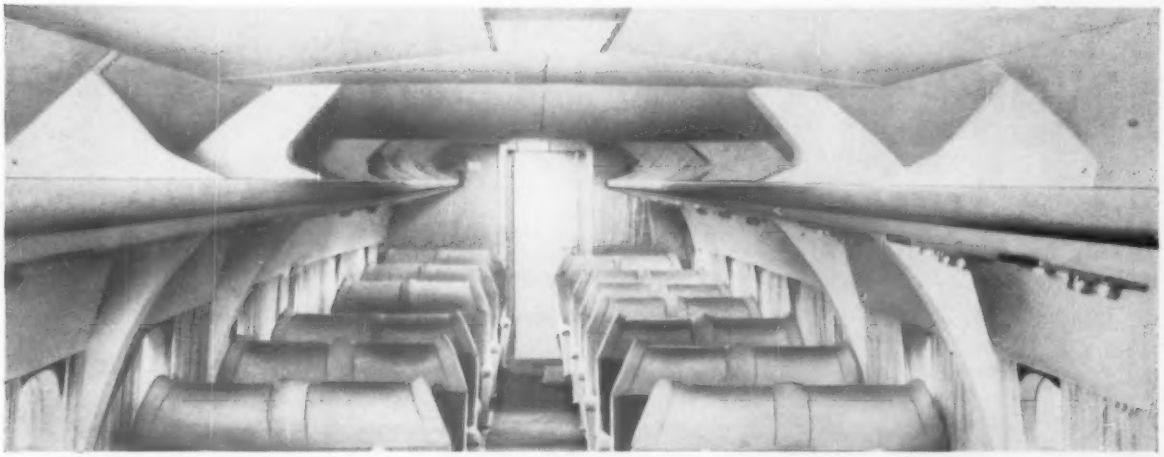

Photograph showing the interior of the Handley Page Dart Herald. The hat rack incorporating the air conditioning ducting is fabricated from laminated glasscloth. Similar techniques will be used for fabricating air conditioning and ventilation components for the DH 121 Trident.

Polyester Resinated glasscloth air pressure ducting for the Vickers Vanguard. High strength/weight ratio, excellent fatigue resistance and thermal insulation are the main advantages offered by this type of construction.

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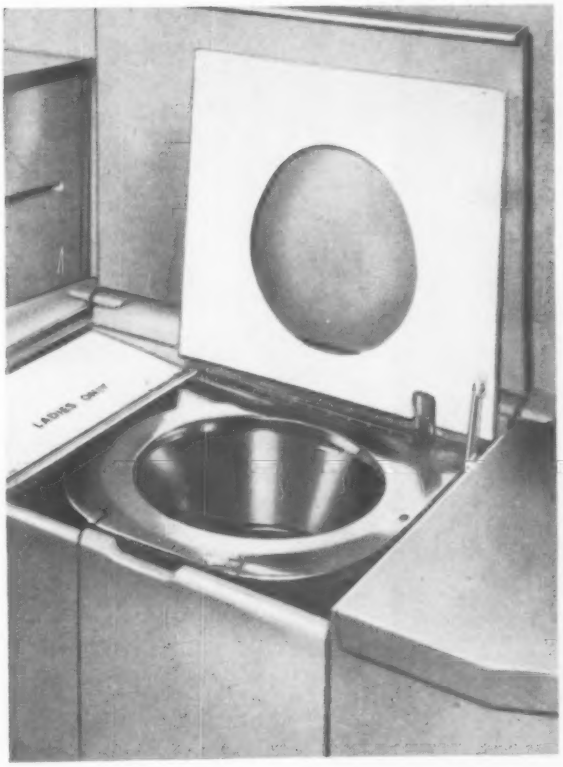

This lightweight stainless steel toilet unit employs a recirculating flushing system. The size illustrated left weighs 16 lb., it was designed by us specially for the Handley Page Dart Herald and is now specified for the Armstrong Whitworth Argosy.

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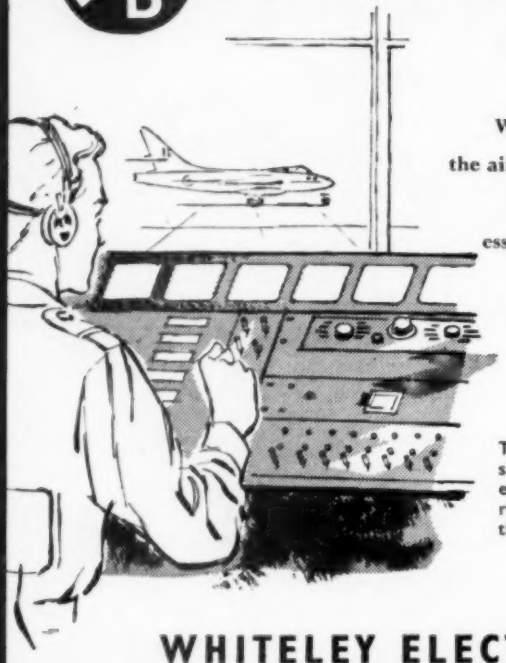

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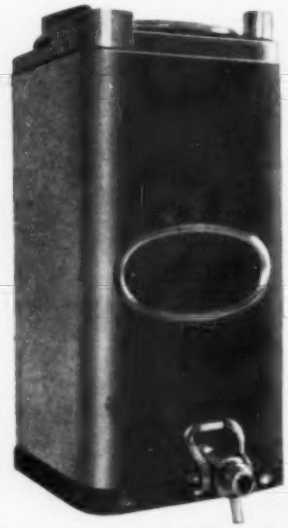

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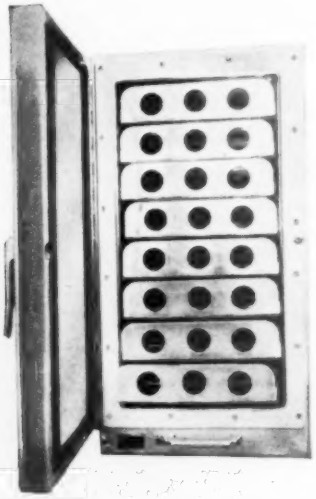

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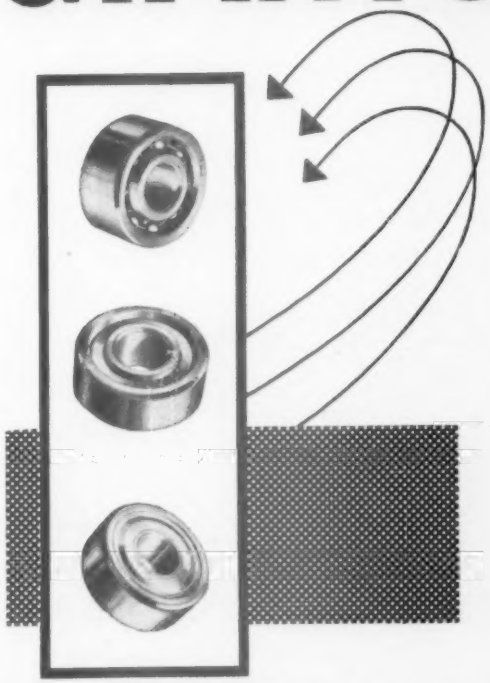

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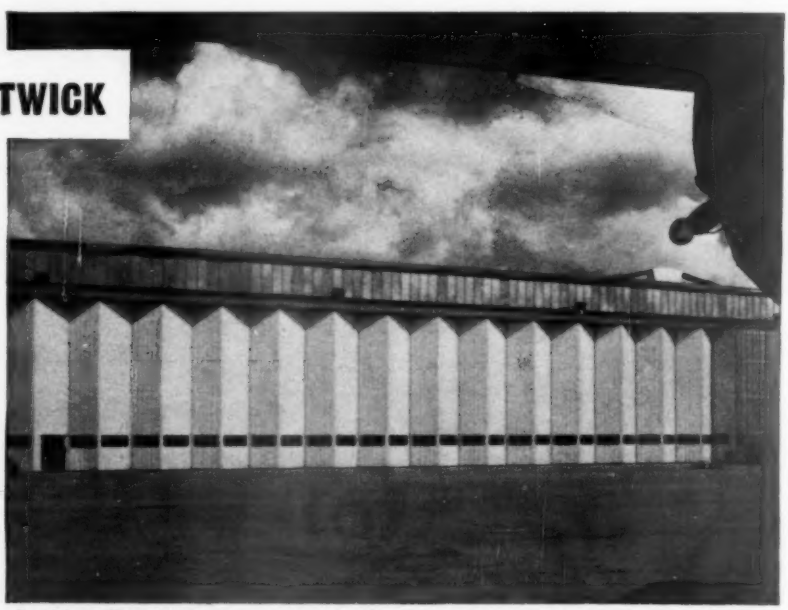

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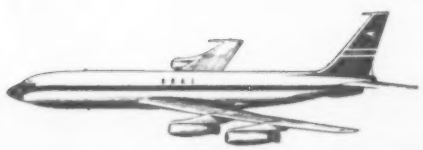

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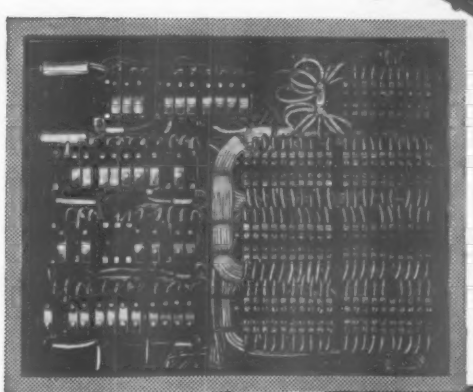

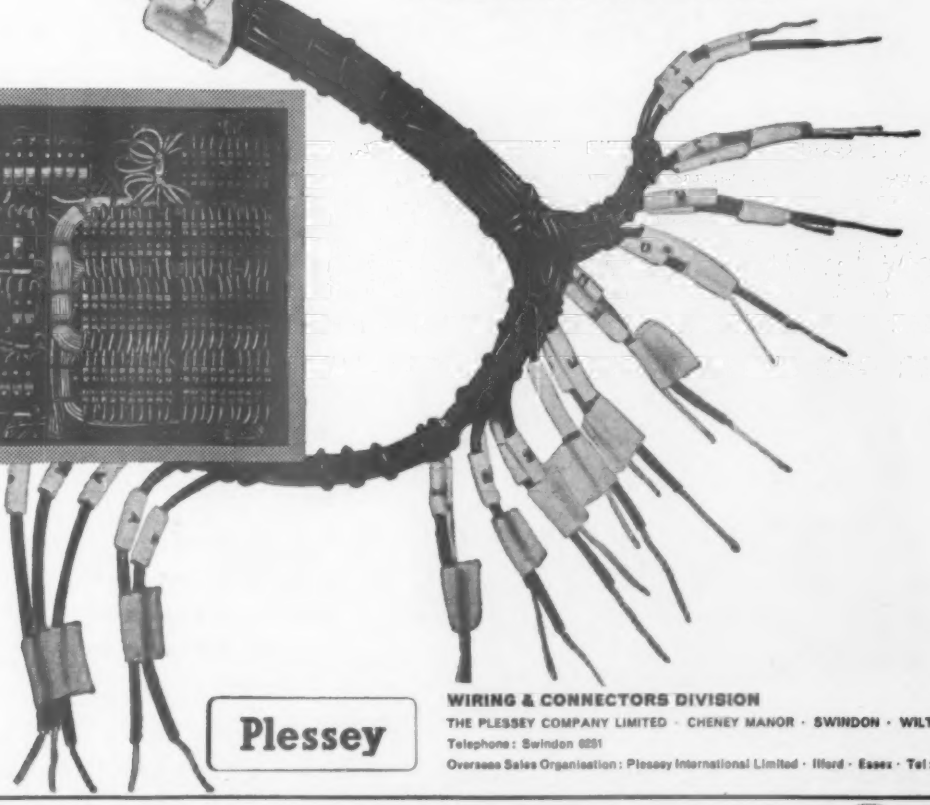

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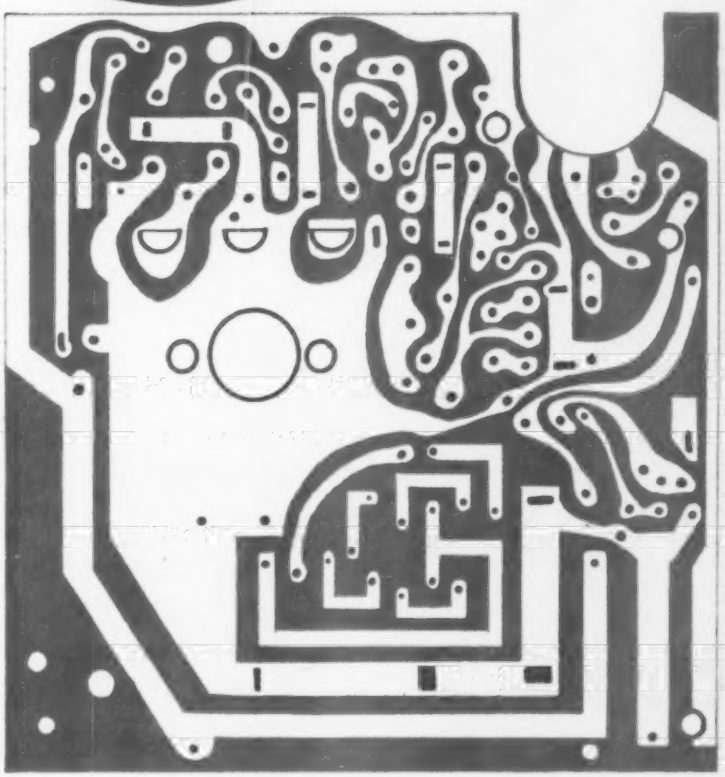

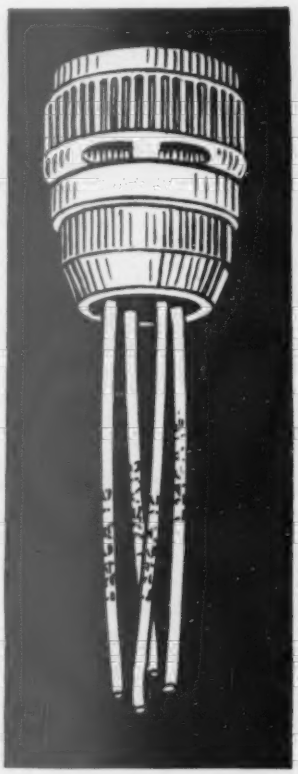

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APL/118

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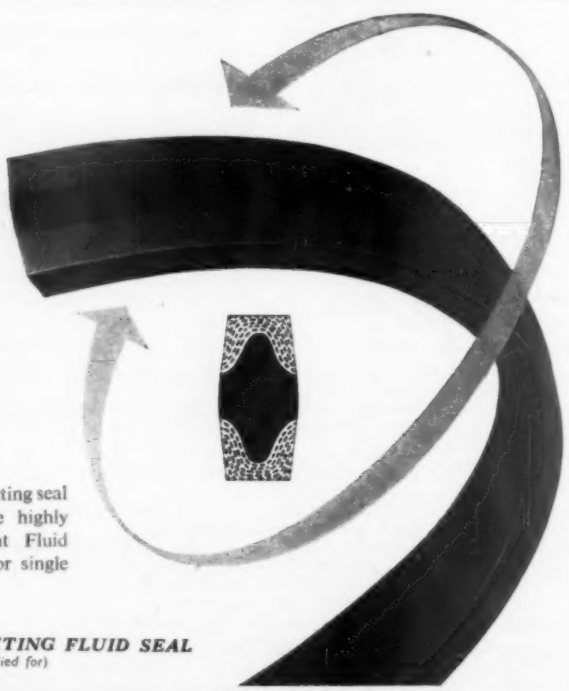

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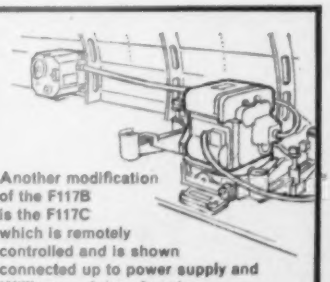
No. of exposures: 110
Format size: 4½" x 4½"
Film capacity: 50 ft. x 5 in. (detachable magazine)
Spools: international standard size (NATO STANAG 3178)
Shutter: patented twin blade (inter-lens)
Speeds: 1/400, 1/250, 1/125, 1/60
Lens: high resolution ROSS 6 in. f/4.5
Maximum speed: 2 exposures per second
Environmental requirements: To M.O.A. specification SP.24 for use in highly manoeuvrable aircraft (class A) category 3; vibration central region.
Temperature range: from −20°c to +50°c.



Another modification of the F117B is the F117C which is remotely controlled and is shown connected up to power supply and Williamson Intervalometer.

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SPECIFICATIONS

Vibration : To Des.1 and G.100.
Temp. Range : —54°C. to +132°C. Survival —70°C. to 150°C.
Contact Rating : 5 amp. 250 volts A.C., 30 volts D.C., 2.5 amp. D.C.
Pressure Range : In ranges between 50 to 5,000 P.S.I. (3.5 to 350 KG/Cm²).
Pressure Connection: 1/8 in. B.S.P. Female.
Electrical Connection : Plessey Plug Mk. IV CZ48993.
Mounting Arrangement : 4 holes .199 in. dia., 1.625 in. centres.
Overload Working : 7,500 P.S.I. (525 KG/Cm²).
Proof Pressure : 10,000 P.S.I. (700 KG/Cm²).
Weight : 10 ozs.
Dimensions : Overall Height 3.452 in.
Overall Diameter 2.750 in.

NOTE. For high temp. range, alternative electrical connections are required.

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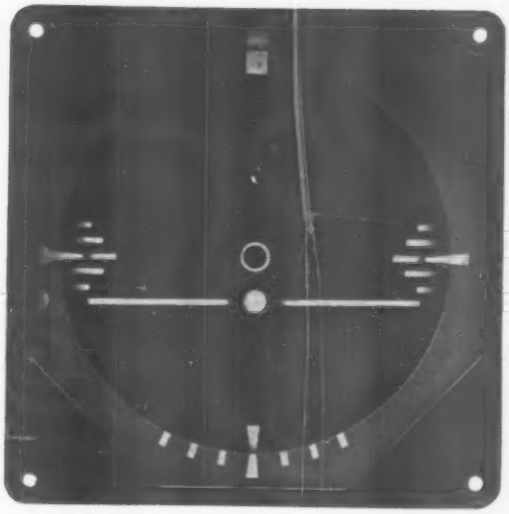

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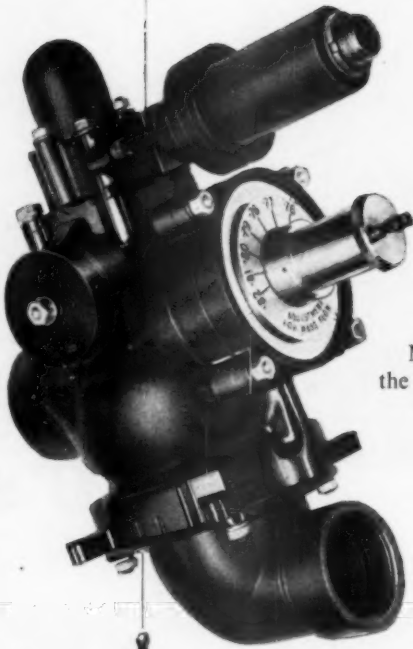

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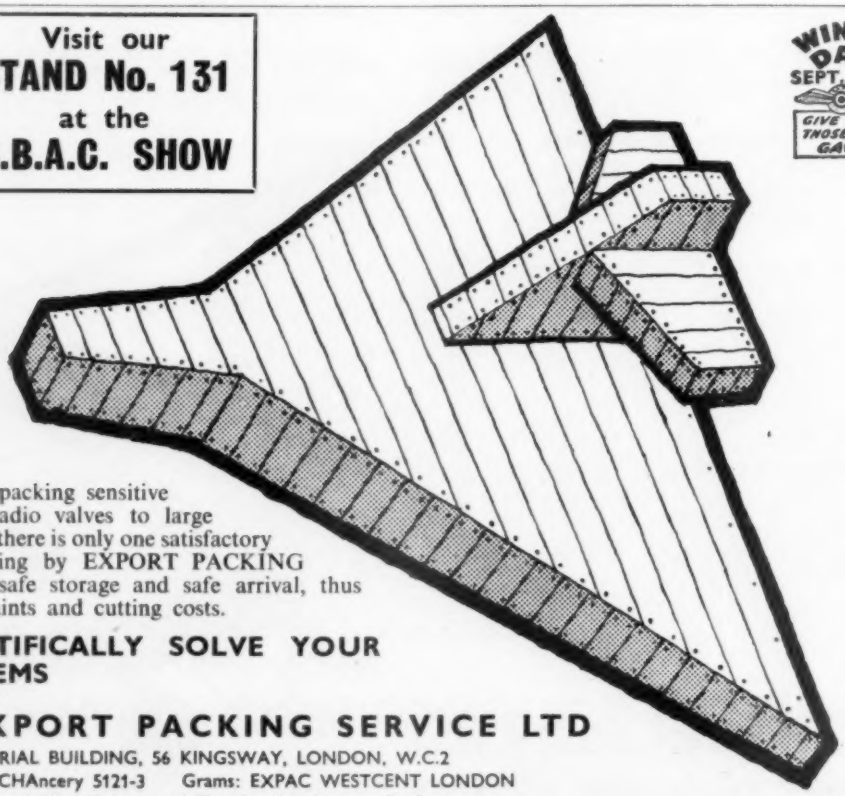

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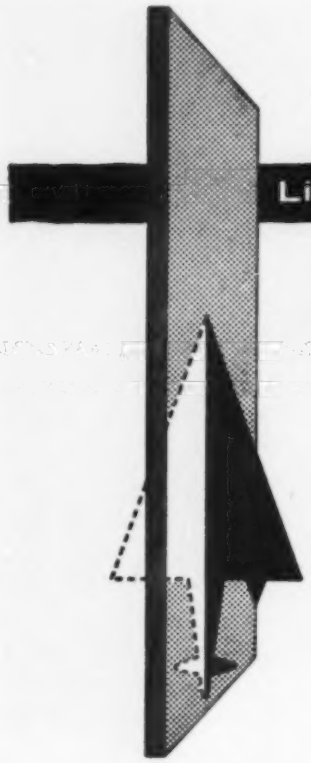

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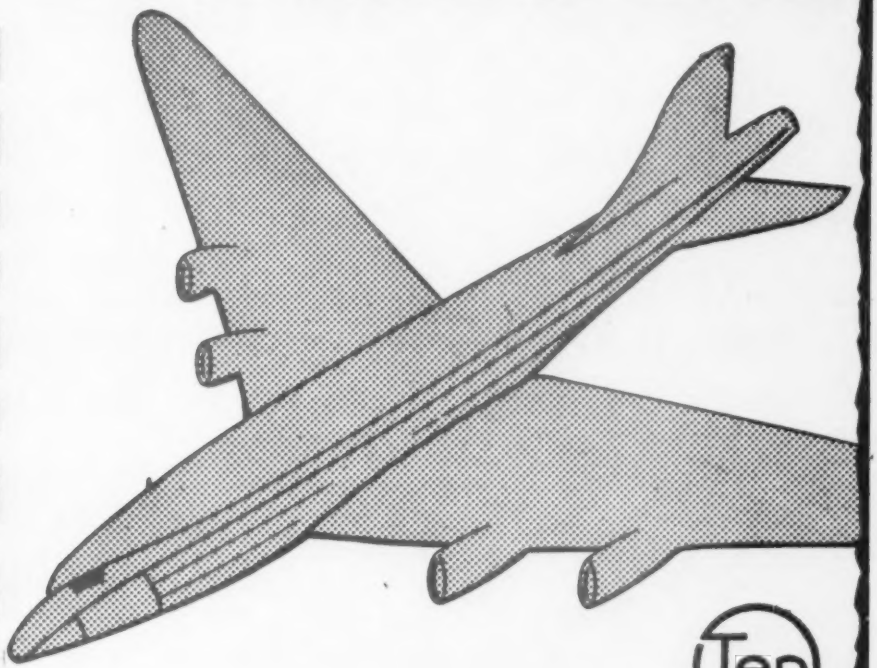

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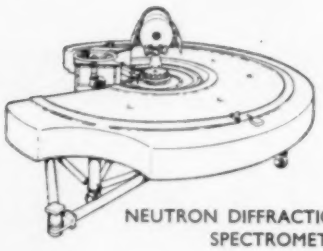
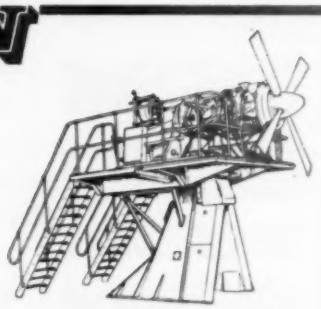


NEUTRON DIFFRACTION SPECTROMETER



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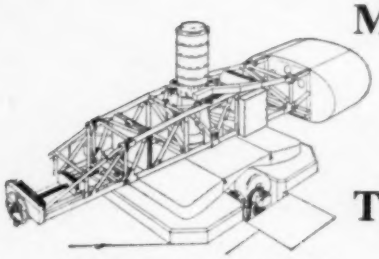

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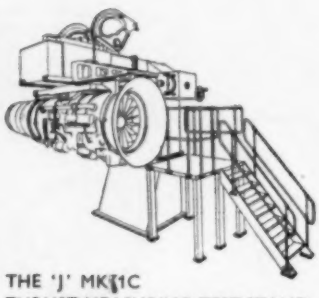

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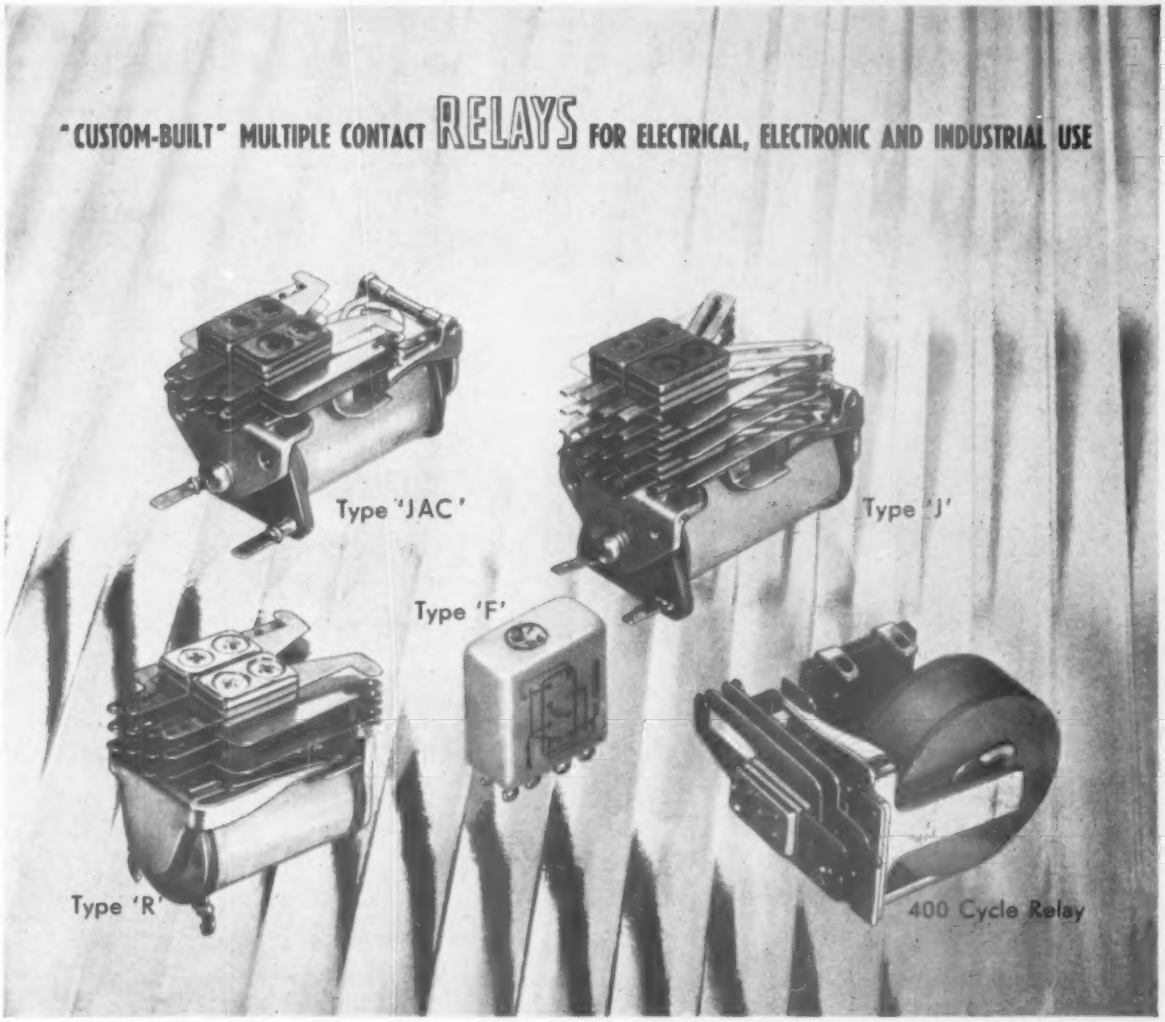

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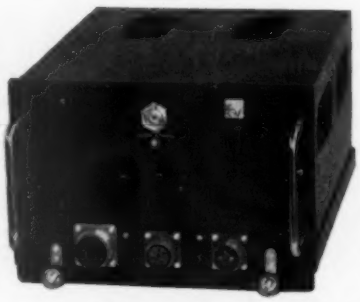

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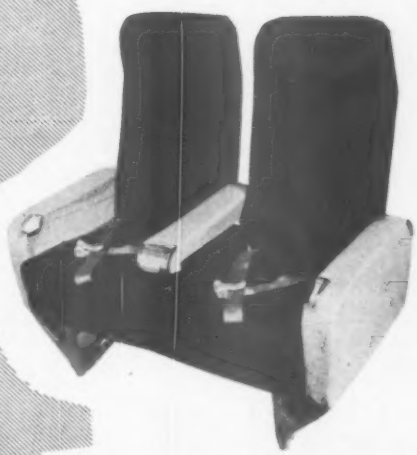

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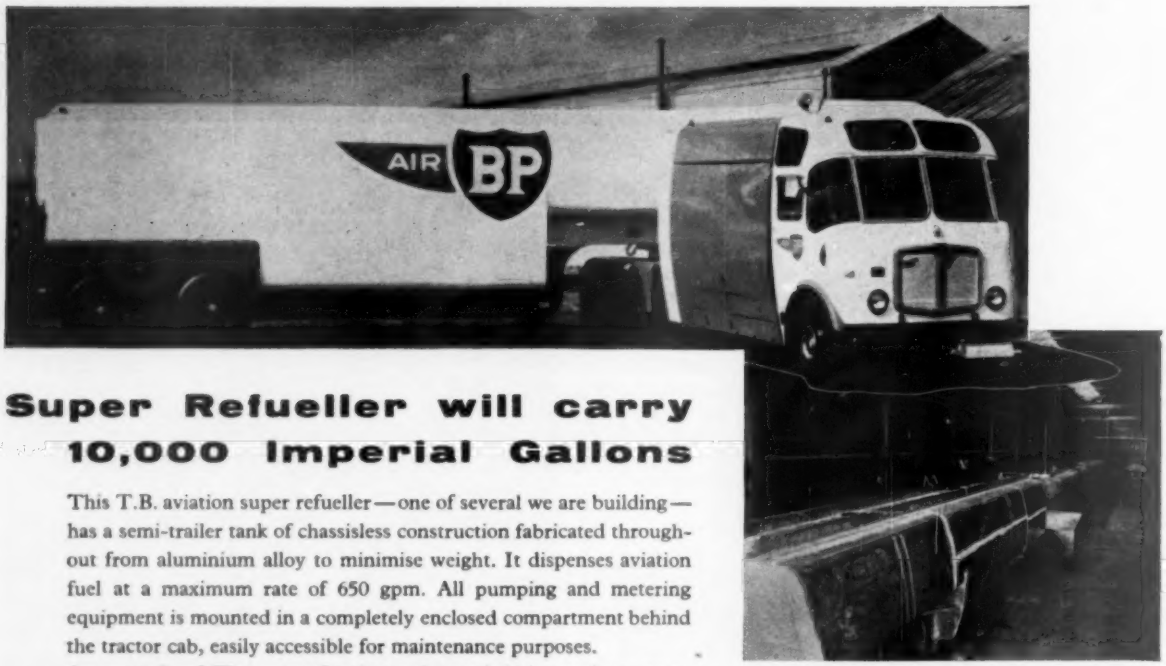

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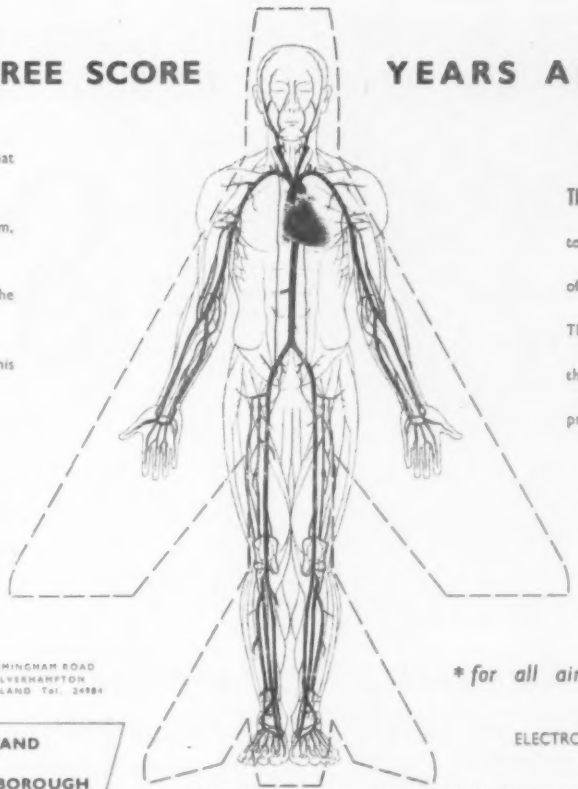

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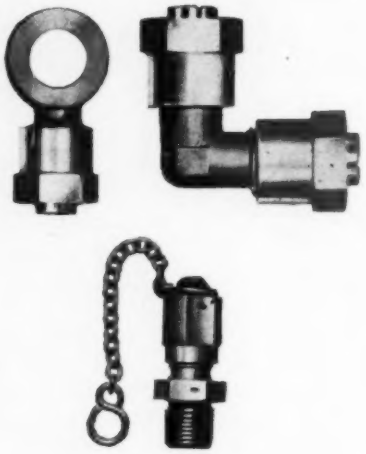

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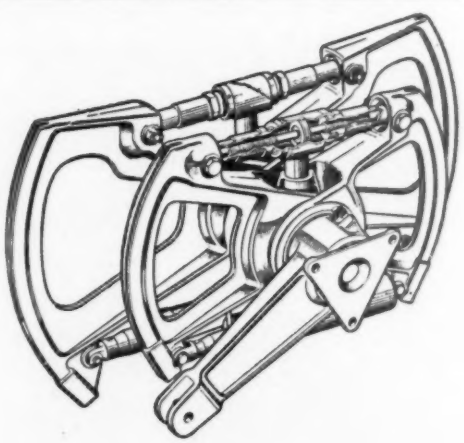

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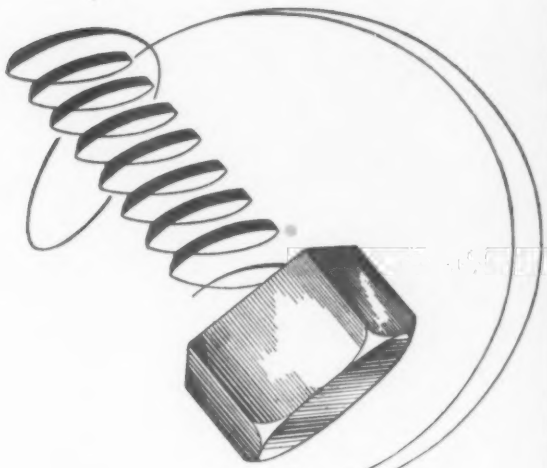

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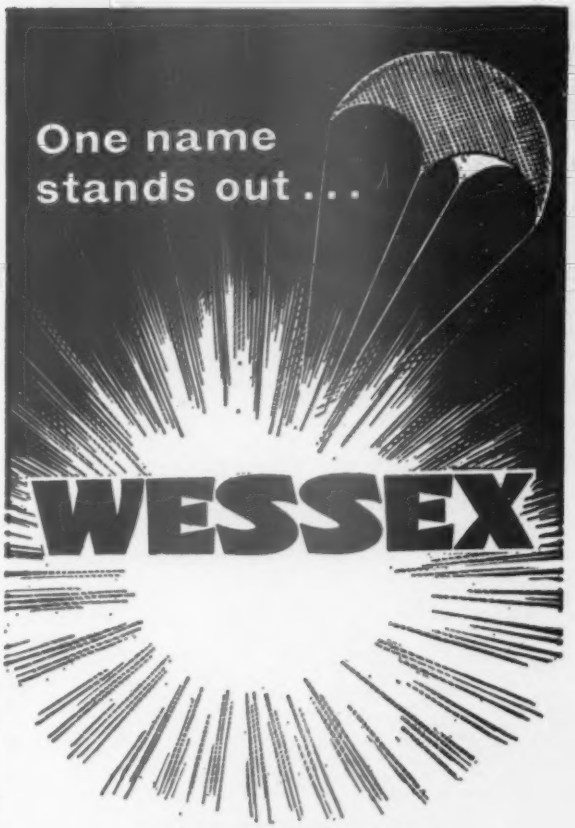

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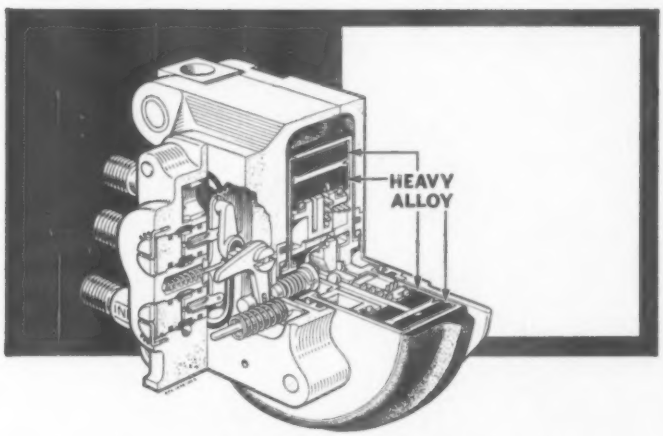

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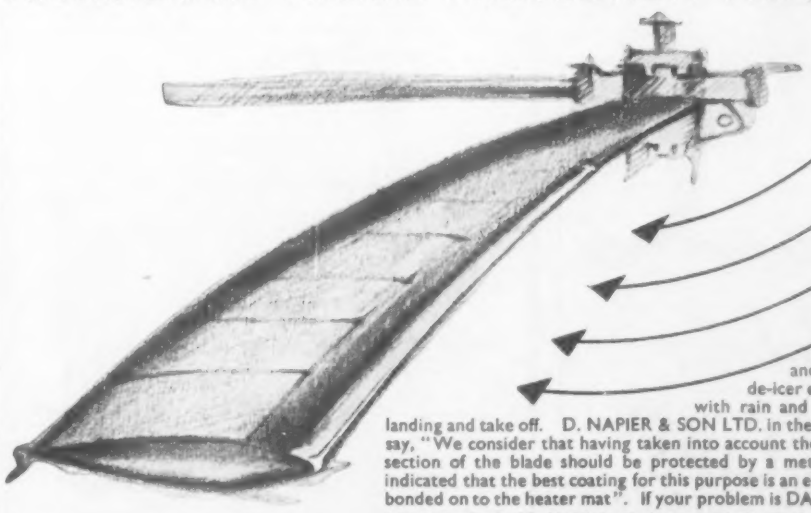

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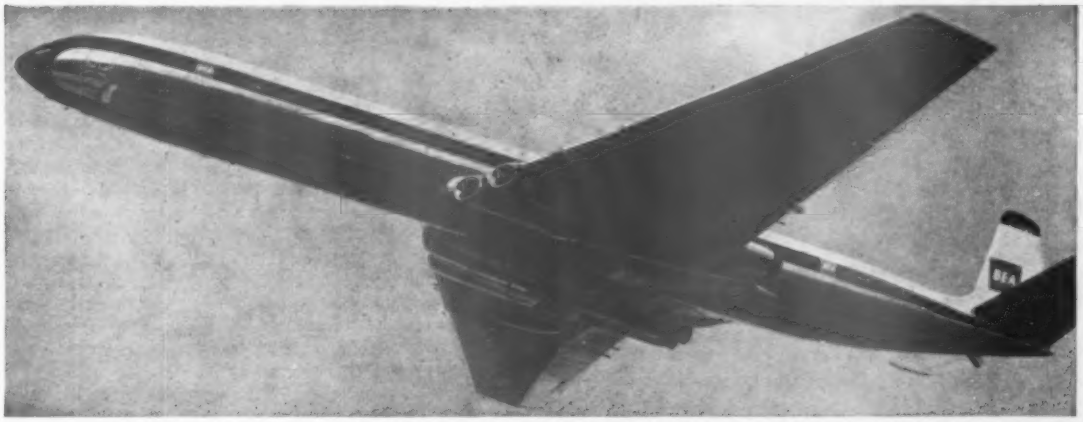

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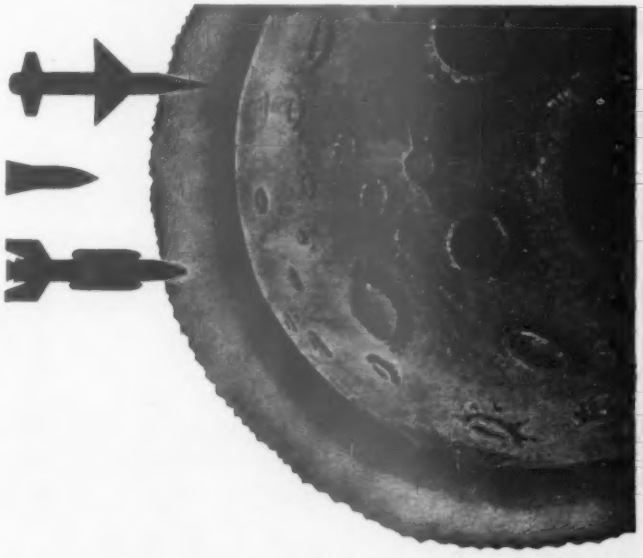

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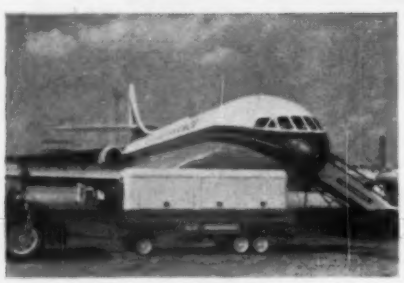

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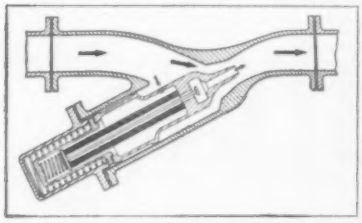

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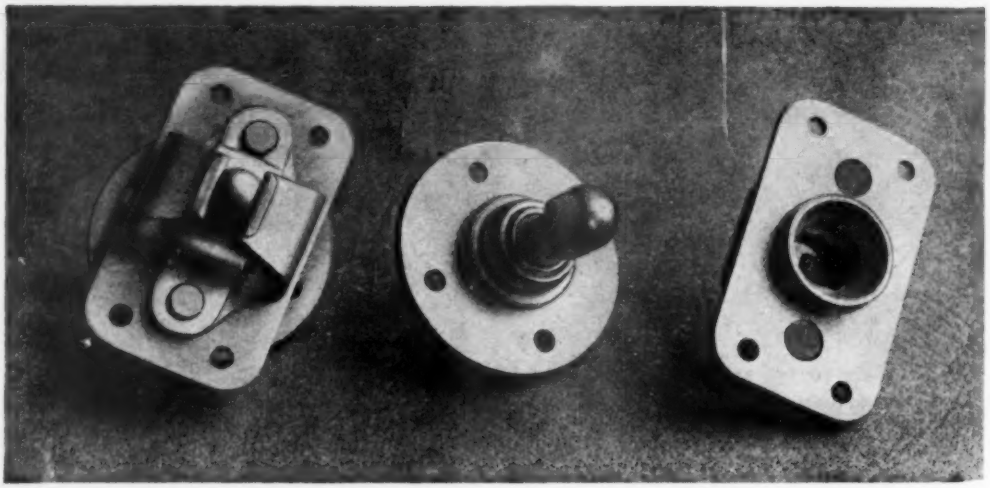

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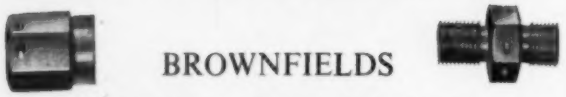

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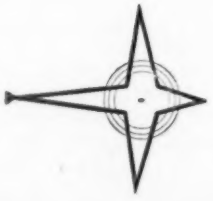

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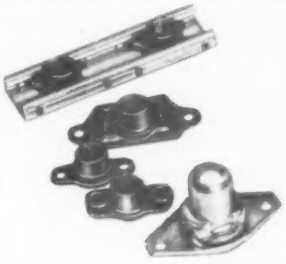

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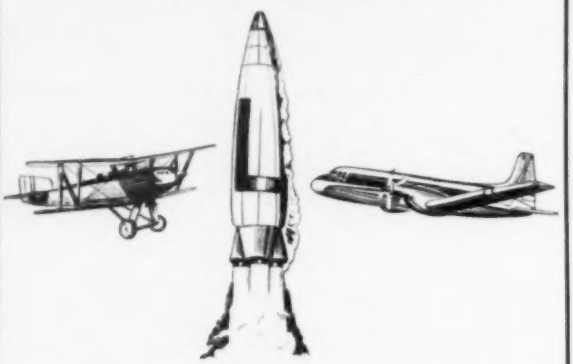

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THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

FROM OVERSEAS AVIATION (C.I.), LTD., OF 6 YORK STREET, ST. HELIER, JERSEY, C.I.:—

APPLICATION NO. 4351 (amended) for a U.K. Internal Service with Viking and Argonaut aircraft for the carriage of passengers and supplementary freight on the route London (Gatwick)-Manchester-Glasgow (Prestwick)-Dundee at an initial frequency of seven return flights weekly increasing later in accordance with traffic demand, for seven years from the date of approval.

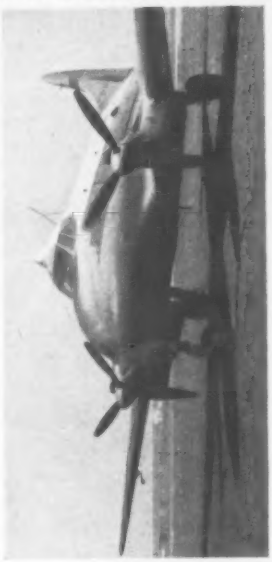
FROM DAN-AIR SERVICES, LTD., OF 36-38 NEW BROAD STREET, LONDON, E.C.2:—

APPLICATION NO. 4458 for a Normal Scheduled Service with Dove, Dakota, B.170 and Ambassador aircraft, for the carriage of passengers, supplementary freight and mail, on the route London (Gatwick)-Kristiansand and/or Sandefjord, at a frequency of three return flights weekly, for seven years from the date of approval.

FROM SILVER CITY AIRWAYS, LTD., OF 62 BROMPTON ROAD LONDON, S.W.3:—

APPLICATION NO. 779/2 for permission to carry incidental passengers on the Vehicle Ferry and Freight service which they are at present authorized to operate with Bristol 170 aircraft, for the carriage of freight, cattle and their attendants and vehicles with associated passengers, on the route Cherbourg-Guernsey and/or Jersey, at a frequency in accordance with traffic demand, until December 31, 1961.

These applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, Westminster, S.W.4, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. 550-4



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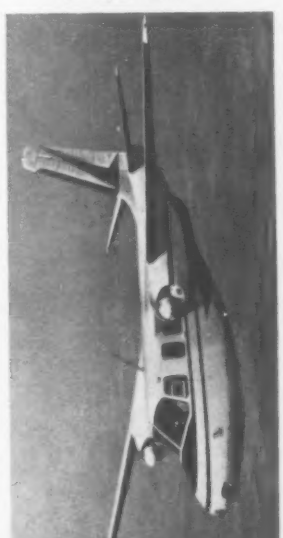

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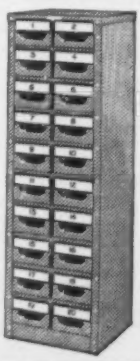

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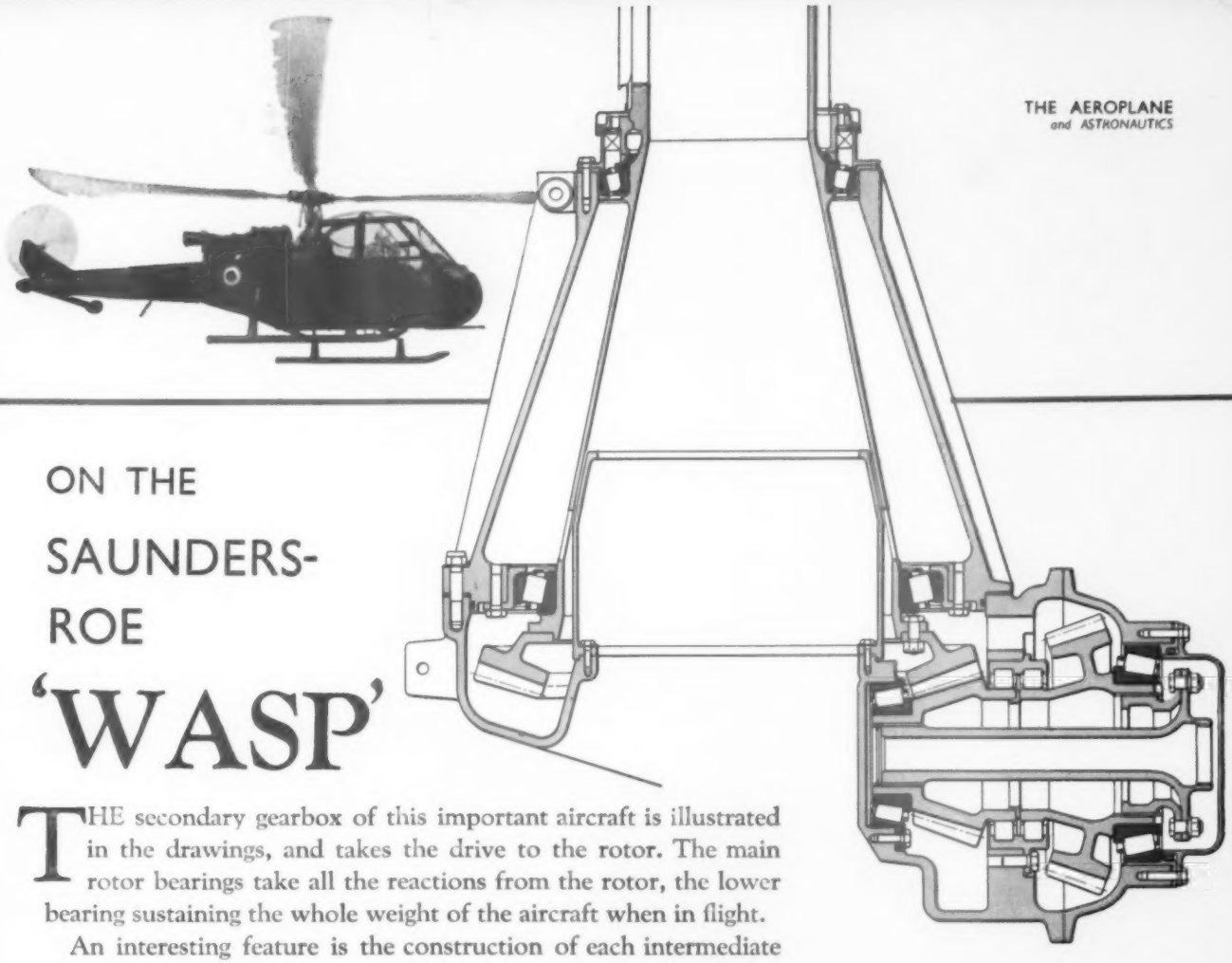

ON THE

SAUNDERS-

ROE

'WASP'

THE secondary gearbox of this important aircraft is illustrated in the drawings, and takes the drive to the rotor. The main rotor bearings take all the reactions from the rotor, the lower bearing sustaining the whole weight of the aircraft when in flight.

An interesting feature is the construction of each intermediate shaft: the two bevels are coupled by a splined 'quill' with a flanged connection; this construction provides a fine vernier adjustment to time the bevels in load-sharing relationship, and in addition provides some torsional elasticity and accommodates any minute radial misalignment.

Each assembly is supported at mid-length by parallel-roller bearings running directly on the bevel gear bosses. Fine axial adjustment of bevels and pre-load of the Timken bearings is effected by shims behind the flange of the small bearing and the end cover: there is also, between the bevel bosses, a selected washer which transmits the pre-load.

The Wasp embodies 42 Timken bearings, including those in the tail-rotor gearbox and the rotor-blade flapping and drag hinges.

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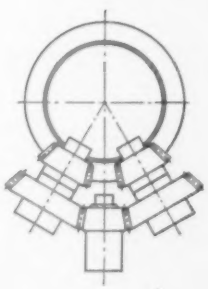

As is shown in the above diagram, a bevel gear on the input shaft meshes with a larger bevel on each of two intermediate shafts; these in turn have smaller bevel gears meshing with the crown wheel on the rotor shaft, giving an overall reduction. In this way the drive is taken off the input bevel at two places, and received by the crown wheel at two places.

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